Printed on Thin Paper for Foreign Circulation.
"THE ENGINEER," FEBRUARY 26, 1932.
With BRITISH INDUSTRIES FAIR AND METALLURGICAL SUPPLEMENTS.

The Engineer.

Established 1856. Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 28, ESSEX ST., STRAND, LONDON, W.C. 2.

VOL. CLIII.—No. 3972] LONDON: FRIDAY EVENING, FEBRUARY 26, 1932 [PRICE WITH SUPPLEMENTS} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES.

Applications are INVITED by the Government of India for an APPOINTMENT as AIRCRAFT and ENGINE INSPECTOR. Pay Rs. 1000, rising by annual increments of Rs. 100 to Rs. 1200 a calendar month. Higher pay not exceeding Rs. 1250-50-1350 a month may be granted to an exceptionally well-qualified applicant. (Pay subject to 10 per cent. temporary emergency cut.) Three years' agreement. Provident Fund. Free passages to India and back. Strict medical examination.

Further particulars and forms of application may be obtained upon request by postcard from the HIGH COMMISSIONER FOR INDIA, General Department, India House, Aldwych, London, W.C. 2. Last date for receipt of applications 12th March, 1932. 8204

Borough of Mansfield.

TENDERS FOR BOOSTER PUMPS—CHESTERFIELD-ROAD PUMPING STATION.

The Corporation invite TENDERS for the MANUFACTURE, SUPPLY, ERECTION, and SETTING TO WORK COMPLETE, of TWO ELECTRICALLY DRIVEN MULTI-STAGE CENTRIFUGAL BOOSTER PUMPS, each Pump with an actual Water Boosting Capacity equal to 6500 gallons per hour, against a total head (including friction) of 100ft.; also ELECTRIC MOTORS, MOTOR-DRIVEN AIR COMPRESSOR, AIR COMPRESSION TANK, ELECTRICAL AUTOMATIC CONTROL GEAR, and ANCILLARY WORK, at their Chesterfield-road Pumping Station, Mansfield.

Copies of the contract, general conditions, specifications, and form of Tender, may be obtained on application to Mr. James Gibson, Engineer and Manager, Water Department, Lime Tree-place, Mansfield.

Tenders, sealed and endorsed "Tender for Booster Plant," to be delivered to the undersigned on or before Thursday, March 3rd, 1932.

The Corporation do not bind themselves to accept the lowest or any Tender.

A. C. SHEPHERD, Town Clerk.

White Hart-street, Mansfield, 19th February, 1932. 8197

City of Birmingham Water DEPARTMENT.

HYDRAULIC POWER STATION, DALTON-STREET. DISPOSAL OF PUMPING PLANT.

The Water Committee of the Corporation of the City of Birmingham is prepared to receive TENDERS from competent firms for the PURCHASE, DISMANTLING, and REMOVAL of HYDRAULIC PUMPING PLANT, situated at the Dalton-street Hydraulic Power Station, Dalton-street, Birmingham.

The plant comprises five gas engines, five horizontal three-throw pressure pumps, two hydraulic accumulators, 18in. diameter by 20ft. stroke, piping, valves, &c. Working pressure 800 lb. per square inch. The plant may be viewed under working conditions prior to 31st March, 1932.

A copy of the general conditions, specification, and form of Tender, together with permit to view, may be obtained from the Secretary of the Water Department, Council House, Edmund-street, Birmingham, on payment of a deposit of £1, which will be returned on receipt of a bona fide Tender. The general conditions include the Birmingham Corporation's Fair Wages and Conditions of Labour Clauses.

Sealed Tenders, on the form provided for the purpose, addressed to the Secretary, Water Department, Council House, and endorsed "Hydraulic Pumping Plant," must be delivered at the Secretary's Office not later than 10 a.m. on Wednesday, 23rd March, 1932.

The Water Committee does not bind itself to accept the highest or any Tender, and reserves the right to accept any part or parts of a Tender.

J. H. BROADLEY, Secretary.

Water Department, Council House, Birmingham, 23rd February, 1932. 8187

County Borough of Sunderland.

DEEP-WATER QUAY.—CONTRACT NO. 5. TO CONTRACTORS.

The Corporation of Sunderland are prepared to receive TENDERS for the SUPPLY and ERECTION of a BELT CONVEYOR for loading coal into ships, and other works in connection therewith, upon a site on and adjoining the new Deep-water Quay on the River Wear at Sunderland, County Durham.

The contract documents may be seen upon application to the Engineer for the scheme, W. H. S. Tripp, M. Inst. C.E., c/o River Wear Commissioners, St. Thomas-street, Sunderland, or may be obtained from him on payment of a deposit of Five Pounds by crossed cheque, which will be returned on receipt of a bona fide Tender accompanied by the whole of the documents issued.

Tenders, which will only be considered if made upon the form supplied, must be completed in accordance with the detailed instructions incorporated in the documents, enclosed in a sealed cover, endorsed "Tender for Deep-water Quay, Contract No. 5," and delivered at the office of the undersigned, Town Hall, Sunderland, not later than Noon on the 9th May, 1932.

The Corporation do not bind themselves to accept the lowest or any Tender.

H. CRAVEN, Town Clerk.

Town Hall, Sunderland, 22nd February, 1932. 8193

London County Council.

TENDERS are INVITED for ALTERATIONS and ADDITIONS to FORCED CIRCULATION HEATING and HOT WATER SUPPLY APPARATUS in "C" Block, Constance-road Institution, Camberwell, S.E. 5.

Specification, form of Tender, &c., may be obtained on and after Monday, 29th February, 1932, on application to the Chief Engineer, Old County Hall, Spring-gardens, S.W. 1, upon payment of £1 by crossed cheque or order payable to the London County Council. (NOTE.—CASH WILL NOT BE ACCEPTED.) This amount will be returnable only if a bona fide Tender has been sent in and not subsequently withdrawn. Full particulars of the work may be obtained on personal application and the contract documents may be inspected before payment of the fee.

Remittances by post should be addressed to the CHIEF ENGINEER, Old County Hall, Spring-gardens, S.W. 1. Personal inquiries at Room 2, No. 3, Warwick House-street, Cockspur-street, S.W. 1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the Instructions for Tender and form of contract and in "The London County Council Gazette."

No Tender received by the Clerk of the Council at County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 14th March, 1932, will be considered.

The Council does not bind itself to accept the lowest or any Tender. 8190

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE
ARRANGED FOR CARD INDEXING.

The Metallurgist.

New Abattoir at Liverpool. (P. 228)
THE ENGINEER, 26 - 2 - 32.

The Phenomena of Lubrication. (P. 239)
THE ENGINEER, 26 - 2 - 32.

Automatic Variable Transmission Gear. (P. 243)
THE ENGINEER, 26 - 2 - 32.

Steel Trade of the World. (P. 232)
THE ENGINEER, 26 - 2 - 32.

British Industries Fair at Birmingham. No. II. (P. 234)
(With an Eight-page Supplement.)
THE ENGINEER, 26 - 2 - 32.

An Accelerated Test for Creep. (P. 241)
THE ENGINEER, 26 - 2 - 32.

INDEX TO ADVERTISEMENTS, PAGE 87.

BRITISH INDUSTRIES FAIR, BIRMINGHAM, STAND No. 2F/3.

PUBLIC NOTICES.

London County Council.

TENDERS are INVITED for the SUPPLY, DELIVERY, and INSTALLATION of FOUR LANCASHIRE STEAM BOILERS, ECONOMISER, FITTINGS, and BRICKWORK SETTING at Lambeth Hospital, Brook-street, S.E. 1.

Specification, form of Tender, &c., may be obtained on and after Monday, 29th February, 1932, on application to the Chief Engineer, Old County Hall, Spring-gardens, S.W. 1, upon payment of £1 by crossed cheque or order payable to the London County Council. (NOTE.—CASH WILL NOT BE ACCEPTED.) This amount will be returnable only if a bona fide Tender has been sent in and not subsequently withdrawn. Full particulars of the work may be obtained on personal application and the contract documents may be inspected before payment of the fee.

Remittances by post should be addressed to the CHIEF ENGINEER, Old County Hall, Spring-gardens, S.W. 1. Personal inquiries at Room 2, No. 3, Warwick House-street, Cockspur-street, S.W. 1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the Instructions for Tender and form of contract and in "The London County Council Gazette."

No Tender received by the Clerk of the Council at County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 14th March, 1932, will be considered.

The Council does not bind itself to accept the lowest or any Tender. 8189

Trinity House, London.

TO BUILDERS AND CONTRACTORS.

The Corporation of Trinity House invite TENDERS for the RENEWAL of FENDER PILES and REPAIRS to the QUAY WALL at Trinity Wharf, East Cowes, Isle of Wight.

Forms of Tender, specifications and drawings can be obtained upon the payment of a deposit of £1 (to be refunded on receipt of a bona fide Tender and the return of all the drawings and documents furnished), on application to the Secretary, Trinity House, Tower-hill, London, E.C. 3, to whom Tenders are to be delivered not later than 10 a.m. on Monday, 21st March, 1932, in sealed envelopes, marked outside "Tender for Renewal of Fender Piles, &c., at East Cowes Depot."

The Corporation of Trinity House do not bind themselves to accept the lowest or any Tender.

M. K. SMITH, Secretary.

8191

PUBLIC NOTICES.

London County Council.

WESTMINSTER BRIDGE.

TENDERS are INVITED for the REMOVAL of the EXISTING PARAPETS for the entire length of the Bridge, on both upstream and downstream sides (except that of Span Five upstream side counting from the Middlesex shore), and the PROVISION and ERECTION of new PANEL CASTINGS, similar to the existing, and the EXECUTION of such REPAIRS and/or RENEWALS of such lengths of the CORNICE and BALLAST PLATE adjoining as may be found necessary, and the REFIXING of the EXISTING COPING CASTINGS. The work will involve the REMOVAL and RE-INSTATEMENT of a WIDTH of the CARRIAGEWAY.

Specification, form of Tender, &c., may be obtained on and after Monday, 29th February, 1932, on application to the Chief Engineer, Old County Hall, Spring Gardens, S.W. 1, upon payment of £5 by crossed cheque or order payable to the London County Council. (NOTE.—CASH WILL NOT BE ACCEPTED.) This amount will be returnable only if a bona fide Tender has been sent in and not subsequently withdrawn. Full particulars of the work may be obtained on personal application and the contract documents may be inspected before payment of the fee.

Remittances by post should be addressed to the CHIEF ENGINEER, Old County Hall, Spring Gardens, S.W. 1. Personal inquiries at Room 2, No. 3, Warwick House-street, Cockspur-street, S.W. 1.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the Instructions for Tender and form of contract and in "The London County Council Gazette."

No Tender received by the Clerk of the Council at County Hall, Westminster Bridge, S.E. 1, after 4 p.m. on Monday, 14th March, 1932, will be considered.

The Council does not bind itself to accept the lowest or any Tender. 8205

NOTICE TO FOREMEN.

The National Foremen's Asso-

CIATION is an Association of Foremen formed to represent them on all questions affecting their supervisory interests.

For full particulars apply GENERAL SECRETARY, 95, Belgrave-road, Westminster, S.W. 1. 7968

PUBLIC NOTICES.

North Kesteven Rural Dis-

TRICT COUNCIL.
WATER SUPPLY TO EASTERN AREA.
PUMPING INSTALLATION.

The above-named Council invite TENDERS for the SUPPLY and ERECTION of DUPLICATE PUMPING MACHINERY at the New Pumping Station at Wanesham Bridge, Metheringham.

Each set, consisting of Multiple-stage Turbine Pump, lifting 9000 gallons hourly a gross lift of 354ft., and a Centrifugal Pump lifting 4500 gallons hourly a gross lift of 114ft., both pumps being driven by Crude Oil Engine through Countershaft.

Full particulars may be obtained from the Consulting Engineers, Messrs. Elliott and Brown, Chartered Civil Engineers, Burton Buildings, Parliament-street, Nottingham, and a copy of the specification and plan on deposit of Two Guineas (by cheque), which will be returned on receipt of bona fide Tender and return of documents.

Tenders to be sent to the undersigned not later than first post on Friday, March 11th.

The lowest or any Tender not necessarily accepted.

By Order, ROBERT EPTON, Clerk to the Council.

2, Bank-street, Lincoln, February, 1932. 8209

Required, Electrical Engineer

and MANAGER, for Aden Settlement Electricity Department, Aden, Arabia. Must be sound, practical Engineer with special experience in Repairs, Renewals, and Maintenance of High-speed Geared Turbines, Water-tube Boilers, Auxiliaries, &c., and conversant with High and Low-tension Distribution and Electrical Apparatus. Must be efficient, abstemious, responsible, and capable of taking full control.

Applicants should apply to the Chairman, Aden Settlement, stating age, married or single, when available, enclosing references and full particulars of experience from school to date, also enclosing recent photograph.

Only those with necessary experience and qualifications need apply.

Terms: Preliminary three years' agreement, with view to permanency. Salary, Rs. 800, rising by yearly increments of Rs. 50 to a maximum of Rs. 1000 per month, plus Rs. 60 travelling allowance, free unfurnished quarters, electric light and water, leave allowance three months on completion of first agreement, additional three months if re-engaged.

First-class B passage British India or equivalent out and home on completion of first term. 8163

Wolverhampton Corporation

WATER UNDERTAKING.

APPLICATIONS are INVITED for the APPOINTMENT of FOREMAN at COSFORD WATERWORKS, at a salary in accordance with the Corporation Grading Scheme, commencing at £190 per annum and rising by three annual increments to £218 per annum, together with free house, coal, and light valued at £40 per annum, the whole subject to a 5 per cent. deduction as contribution to the Superannuation Fund.

Applicants should be skilled working Engineers, and have had previous experience in the Management and Repair of large Steam-driven Waterworks Pumping Plant. The successful applicant will be required to pass a medical examination.

Application forms and details of the duties may be obtained from the undersigned, to whom the written applications on the said forms, accompanied by copies of two recent testimonials, should be delivered NOT LATER THAN NOON ON SATURDAY, THE 12th MARCH, 1932.

B. L. McMILLAN, B.Sc., A.M.Inst.C.E., Water Engineer and Manager.

Town Hall, Wolverhampton. 8188

SITUATIONS OPEN.

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

TO ADVERTISERS UNDER BOX NUMBERS IN THIS CLASSIFICATION.

For the benefit of applicants, the Proprietors are prepared to insert brief notices that vacancies are filled, upon receipt of notifications from the Advertisers. These notices (limited to one line) will be free of charge and co-operation is asked for.

THE Prominent NORTH OF ENGLAND IRON and STEEL COMPANY ADVERTISING the POSITION of SMELTING SHOP MANAGER in the issues of February 5th and 12th THANK those GENTLEMEN who applied for the POSITION and desire to advise them that the POST has now been FILLED. 8210 A

ENGINEER REQUIRED for Post, Chief Mechanical Engineer, large Mining and Smelting Company abroad, having its own hydro-electric station, auxiliary steam turbines and Diesels, complete mine equipment, ore reduction mill, gravity and flotation, lead smelter refinery and ancillary plant, large machine locomotive wagon shops and foundry. Previous experience similar capacity and ability administer departmental staff absolutely essential. Working knowledge electricity desirable, but not essential.—Write in first instance, Box T. 126, Willing's, 133, Moorgate, E.C. 2. 8215 A

SITUATIONS OPEN (continued) Page 2.
SITUATIONS WANTED, Page 2.
AUCTIONS, Page 88.
PATENTS, Page 4.
PARTNERSHIPS, Page 2.
EDUCATIONAL, Page 4.
MACHINERY, &c., WANTED, Page 2.
FOR HIRE, Page 88.
BUSINESSES and PREMISES (For Sale, etc.), Page 88.
AGENCIES, Page 2.
MISCELLANEOUS, Page 4.
FOR SALE, Pages 4 and 88.
WORK WANTED, Page 88.

For Advertisement Rates see First Column Overleaf.

The Engineer

Annual Subscription Rates

(including postal charges).

Subscriptions will be accepted by the Publisher direct or through a newsagent at the rates and in the currencies stated below :—

BRITISH ISLES ..	£3 5 0		
CANADA	£3 3 0	Thick Paper Ed.	
	£2 18 6	Thin Paper Ed.	
ABROAD	£3 7 6	Thick Paper Ed.	
(except Canada)	£3 3 0	Thin Paper Ed.	

AFRICA	Central News Agency. All Branches
£3 7s. 6d.	CAPE TOWN : Wm. Dawson and
£3 3s. 0d.	Sons, Ltd., 20–31, Long-street (Box 489)
	JOHANNESBURG : C. Juta and Co.
ARGENTINE ..	BUENOS AIRES : Mitchell's Book
* £3 7s. 6d.	Store, 576, Cangallo
† £3 3s. 0d.	
AUSTRALIA ..	Gordon and Gotch (Australasia),
* £3 7s. 6d.	Ltd. All Branches
† £3 3s. 0d.	MELBOURNE : Robertson and Mullens, Elizabeth-street
BELGIUM ..	BRUXELLES : E. Graddon, 78, Rue
* Fr. 590	du Marché-aux-Herbes
Fr. 550	BRUXELLES : W. H. Smith and Son, 78–80, Rue du Marché-aux-Herbes
CANADA	American News Company, Ltd. All
* $15·25	Branches
† $14·25	MONTREAL : Gordon and Gotch, Ltd., 334, Notre Dame-street, W.
	TORONTO : Wm. Dawson and Sons, Ltd., 87, Queen-street East
	TORONTO : Gordon and Gotch, Ltd., 61, Queen-street West
CEYLON	COLOMBO : Wijayartna and Co.
* Rs. 44·5	
† Rs. 41·5	
CHINA	HONG KONG : Kelly and Walsh,
* $37	Ltd.
† $34·5	SHANGHAI : Kelly and Walsh, Ltd.
EGYPT	CAIRO : Express Book and
* £3 7s. 6d. (Pt. 330) Stationery Store, 9, Chareh	
† £3 3s. 0d. (Pt. 308) Maghrabi	
FINLAND ..	HELSINGFORS : Akademiska Bok-
* M. 650	handeln, Alexandersgatan, 7
† M. 605	
FRANCE	PARIS : Boyveau and Chevillet, Rue
* Fr. 618	de la Banque, 22
† Fr. 390	PARIS : Librarie Berger-Leverault, 229, Bld. St. Germain
	PARIS : Brentano's, 37, Av. de l'Opera
	PARIS : Dunod, 92, Rue Bonaparte
	PARIS : W. H. Smith and Son, 248, Rue de Rivoli
GERMANY ..	BERLIN - LICHTERFELDE - WEST :
* R. mks. 70·00	H. Hermanns, Dahlemer Strasse,
† R. mks. 65·00	64 A
	LEIPZIG : K. W. Hiersemann, Konigstrasse 29
HOLLAND ..	ROTTERDAM : Hector's Boek-
* Fl. 41·00	handel, Noordblaak 59
† Fl. 38·00	ROTTERDAM : Techn. Boekhandel, "Plan C," Gelderschestraat 4
INDIA	BOMBAY : Thacker and Co., Ltd.
* Rs. 45	CALCUTTA : Thacker, Spink and Co.
† Rs. 42	
ITALY	MILAN : Ulrico Hoepli
* Lire 300	ROME : Maglioni and Strini, 307,
† Lire 280	Corso
	ROME : Fratelli Treves, Corso Umberto 1, 174
	ROME : Fratelli Bocca
	TURIN : Rosenberg and Sellier, v. Maria Vittoria 18, and their Branches at Naples and Rome
JAPAN	Maruzen Co. All Branches
* £3 7s. 6d.	
† £3 3s. 0d.	
JAMAICA	KINGSTON : Educational Supply
* £3 7s. 6d.	Co.
† £3 3s. 0d.	
NEW ZEALAND	AUCKLAND : Whitcombe and
* £3 7s. 6d.	Tombe, Ltd.
† £3 3s. 0d.	Gordon & Gotch, Ltd. All Branches
	NAPIER : J. Wilson Craig and Co.
RUSSIA	LENINGRAD : Mezhdunarodnaya
* £3 7s. 6d.	Kniga, Prospect Volodarsky, 53A
† £3 3s. 0d.	MOSCOW : "Litledat," Kousnet-sky Most, 515
STRAITS SETTLEMENTS—SINGAPORE : Kelly and	
* $29·25	Walsh, Ltd.
† $27·25	
SWEDEN	STOCKHOLM : A/B Wennergrens
* Kr. 61·00	Journal-expedition, Stockholm 1
† Kr. 57·00	STOCKHOLM : A/B C. E. Fritzes Kungl., Hofbokhandel, Fredsgatan, 2
SWITZERLAND	BERNE : Joh. William De Groot,
* Fr. 85·20	Laupenstr, 5
† Fr. 79·50	ZURICH : Rosa Leibowics, 4, Ankerstr.
UNITED STATES OF AMERICA	International News Co., 131, Varick-street, New York, N.Y., and all Branches
* $16·40	Entered as second-class matter at the Post
† $15·25	Office, New York, N.Y., December 12th, 1896, under the Act of March 3rd, 1879 (Section 397, P.L. & R.)

* *Thick Paper.* † *Thin Paper.*

These rates are liable to alteration if exchange fluctuations require it.

*** READING CASES, *to hold two copies of* THE ENGINEER, *cloth sides and leather backs, can now be supplied at 4s. 9d. each, 5s. 3d. post free.*

"THE METALLURGIST."

This Supplement, which deals with the Science and Practice of Metallurgy, both ferrous and non-ferrous, is published free with the last issue of THE ENGINEER in each calendar month.

ADVERTISEMENTS.

The charge for Classified Advertisements is 1/- per line up to one inch—minimum charge 4/-; those occupying one inch or more at the rate of 12/- per inch. Orders must be accompanied by a remittance. The rates for Displayed Advertisements will be forwarded on application. Classified Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication).

Letters relating to the Advertisement and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters are to be addressed to the Editor of THE ENGINEER.

THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in THE ENGINEER, may be obtained free of charge on application to the Publisher.

Postal Address, 28, Essex Street, Strand, London, W.C. 2.
Teleg. Address, "Engineer Newspaper, Estrand, London." Tel.: Central 6565 (5 Lines).

SITUATIONS OPEN (continued)

GENTLEMAN, Age 28-35, with Commercial ability and experience, is REQUIRED in a Managerial Capacity for Provincial Branch of important Concern. The commencing remuneration is reasonably substantial.

Future possibilities depend on the capabilities of the selected applicant.

Men whose business progress to date is outstanding should send fullest particulars, in confidence, to X.Y., c/o Robbins, Olivey and Lake, 218, Strand, London, W.C. 2. 8180 A

MESSRS. FILTRATORS, Ltd., FEED-WATER SPECIALISTS, of HAZLITT HOUSE, SOUTHAMPTON BUILDINGS, HOLBORN, W.C. 2, REQUIRE the SERVICES of an ASSISTANT TECHNICAL SALES MANAGER for their head office. Applicants must have a good record and sound technical experience.—Apply in writing to the MANAGING DIRECTOR, giving full details as to experience, qualifications, and salary required. 8192 A

OLD-ESTABLISHED British FIRM of Centrifugal Pump Makers REQUIRE REPRESENTATIVES in Calcutta, Bombay and Madras. Previous experience pumps preferred. Commission basis only. Full particulars organisation and standing required.—Address, P2111, The Engineer Office. P2111 A

CHIEF DRAUGHTSMAN REQUIRED for Works situated just outside the London district, employing 700 hands in the manufacture of Complicated Precision Machinery. The applicant must be a good Designer and possess proved executive and organising ability.—Address, giving particulars of experience, age, and salary required, P2083, The Engineer Office. P2083 A

DRAUGHTSMAN, Expert in Reciprocating Pumping Machinery and Pumps. Permanent post, good salary and prospects. State training, experience and salary required.—Address 8147, The Engineer Office. 8147 A

SITUATIONS WANTED.

AN ENGINEER, 1st B.O.T., 6 Years in Charge oil fuel storage installation, tin can making, &c., DESIRES POST.—Address, P2100, The Engineer Office. P2100 B

A FULLY Qualified ELECTRICAL and MECHANICAL ENGINEER REQUIRES APPOINTMENT; considerable experience in the erection of modern power plant, lighting and complete factory lay-out, overhead and underground systems, jointing and re-winds; well up in modern wireless and sound amplification; references include 10 years with David Bentley, Leicester, supervising chief engineer; B.T.H., Rugby, control of large power contracts; Bury Power Co., chief engineer.—PERRY, 26, Glenboro-avenue, Bury. P2104 B

AGENT and ENGINEER, M. Inst. C.E., M. Inst. Struct. E., SEEKS ENGAGEMENT. Heavy bridgework, foundations, compressed-air sinking and tunnelling, concrete and earthwork, &c. First-class references.—Address, P2107, The Engineer Office. P2107 B

A.M.I. MECH. E., Age 37, 20 Years' Experience high-class engineering, toolroom, millwrights, foundry, D.O., works management, very comprehensive technical training, DESIRES POSITION with progressive firm.—Apply, J., 19, Wood-lane, Isleworth. P2096 B

CAPABLE PUBLICITY MANAGER, Age 34, Experienced in engineering advertising, able to plan and execute complete advertising campaigns, prepare catalogues, leaflets, &c., and write technical and semi-technical articles. Firms having an opening for such a man are asked to write.—Address, P2121, The Engineer Office. P2121 B

SITUATIONS WANTED (continued)

BUYER, 27, Single, OFFERS IMMEDIATE SERVICES for progressive position with mfrs. or mchts.; 10 yrs.' exp. gen. and elec. engg. concerns; keen man, sound refs.—Address, P2102, The Engineer Office. P2102 B

CHIEF SALES ENGINEER (General Engineering), PREPARED to ACCEPT IMPORTANT POSITION only. Take Charge Outside Staff and Organise for Success.
Address, P2124, The Engineer Office. P2124 B

ENGINEER, B.Sc. (Lond.), SEEKS POST. Late Chief Engineer, British Mannesmann Tube Co. and Hans Renold, Ltd.—Apply, S. A. S., 2, Dorset-avenue, Romford, Essex. P2115 B

ENGINEER DESIGNER, Workshop and D.O. training with well-known general engineers, experienced in design and development of excavators, cranes, &c., DESIRES POST with prospects upon proving ability.—Address, P2123, The Engineer Office. P2123 B

ENGINEER GENERAL MANAGER, Economic, practical, expert administrator and organiser, outstanding successes in reorganisation of important and varied industrial companies, resulting in proved large savings and increased efficiency, OPEN to CONSIDER permanent executive or consulting APPOINTMENT.—Address, P2067, The Engineer Office. P2067 B

ENGINEER, Mechanical and Electrical, SEEKS POSITION. Good technical and industrial experience, knowledge of factory control.—Address, P2122, The Engineer Office. P2122 B

ENGINEER SURVEYOR, with 16 Years' Service with insurance company, DESIRES RE-ENGAGEMENT.—Address, 8214, The Engineer Office. 8214 B

ENGINEER SALESMAN, Resident in London, DESIRES to REPRESENT good FIRM. First-class and extensive experience with the best firms. Record of successful salesmanship over wide range of machinery for home and export. Telephone address offered.—Address, P2128, The Engineer Office. P2128 B

ENGINEER (29), First-class B.O.T. Certificate, experienced fitter and turner, SEEKS EMPLOYMENT. Excellent testimonials. Any suitable post, moderate salary, interview arranged.—Address, P2125, The Engineer Office. P2125 B

ENGINEER (29), B.Sc. (Eng.), 5 Years' Shops, 3 years' D.O., 5 years' Continental experience, fluent French and German, excellent references, SEEKS RESPONSIBLE POSITION with British Firm requiring man to travel abroad in their interests or with Continental Firm in England.
Address, P2108, The Engineer Office. P2108 B

GERMAN-SPEAKING MECHANIC (25), Trained fitter and turner, good experience, general, and with Diesel engines, DESIRES RE-ENGAGEMENT.—C. TODMAN, Hazelcell, Compton, Hants. P2075 B

METALLURGIST and CHEMICAL ENGINEER, ferrous and non-ferrous, specialist in heat treatment, is AVAILABLE to take up a PART-TIME POSITION in a consulting capacity. Long experience in this country and abroad.—Address, P2099, The Engineer Office. P2099 B

SALES ENGINEER, 33, Keen, Successful, Adaptable, first-class works training and experience, highest references; available at termination of present engagement for APPOINTMENT as REPRESENTATIVE over London and South.—Address, P2110, The Engineer Office. P2110 B

SITUATIONS WANTED (continued)

SALES ENGINEER (34), Works, D.O., &c., 11 years' sales experience, boiler-house plant, water purification, instruments, general engineering plant, tank work, &c., exp. office management, DESIRES CHANGE.—Address, P2129, The Engineer Office. P2129 B

STRUCTURAL ENGINEER, M.I. Struct E., SEEKS APPOINTMENT; expert knowledge of design, site surveying and superintending erection of structural steel work. Highest references. Moderate salary.—Address, P2119, The Engineer Office. P2119 B

THOROUGHLY RELIABLE ENGINEER, B.O.T., 1st Class, steam turbines, oil fuel, refrigeration, and general experience, adaptable, age 39, SEEKS POST, home or abroad. References.—Address, P2095, The Engineer Office. P2095 B

TO MANUFACTURERS OF HYDRAULIC AND GENERAL MACHINERY.—ENGINEER, with first-class connection, Birmingham and Midlands, wide knowledge of hydraulic machinery in all its applications, able to introduce special lines, not only in hydraulic plant, but in other directions, DESIRES APPOINTMENT with enterprising and up-to-date firm who are looking for extended business, as REPRESENTATIVE, DESIGNER, SALES ORGANISER, or similar responsible POST.
Address, P2091, The Engineer Office. P2091 B

WANTED, POSITION, Home or Abroad (Age 39), 15 years' executive three concerns, drop forging, press work, blacksmithing, die sinking, toolmaking, railway or motor car work. Excellent references.—Address, P2126, The Engineer Office. P2126 B

DRAUGHTSMAN and DESIGNER, Power Plant, mining, and mechanical, 9 years shops, 12 years drawing-office, SEEKS SITUATION. Disengaged.—R. E. LEE, 2, Woodmansterne-crescent, S.W. 16. P2098 B

DRAUGHTSMAN DESIGNER SEEKS ENGAGEMENT, London or Provinces; 20 years D.O., general and hydraulic, steam turbines and pumping engines, plant and machinery lay-out, steel structural design, wide experience stress calculation, accustomed to carrying through complete schemes. Recent position, 3 years assistant to London engineer.—Address, P2092, The Engineer Office. P2092 B

DRAUGHTSMAN, Mechanical, G.I. Mech. E., DESIRES POSITION. Excellent technical training, experience die casting, foundry and general engineering. Higher National Diploma. Prepared to go anywhere.—Address, P2097, The Engineer Office. P2097 B

DRAUGHTSMAN (30) REQ. SIT. Capable, Neat, accurate; 13 years' experience design, press tools, jigs, fixtures, special purpose machines, &c., mainly for economical production of electrical instruments.—Address, P2118, The Engineer Office. P2118 B

DRAUGHTSMAN (30), Secy. and Tech. Educn., 5 yrs. apprent. shops and D.O., expd. steam and Diesel eng., details and pipe arrangements, W.T. boilers and accessories, fans and dust-catching equipment, SEEKS OPENING. Full details and refs.—Address, P2116, The Engineer Office. P2116 B

GOOD DRAUGHTSMAN, Ex. 22 Years Constructional, mechanical, light cranes, jig tools and plant lay-out, AVAILABLE for IMMEDIATE APPOINTMENT.—Address, P2093, The Engineer Office. P2093 B

SENIOR DRAUGHTSMAN, Experienced in Design of E.P. and electric railway signalling apparatus, SEEKS CHANGE with a view to obtaining more scope for his abilities. Technical education and shop experience.—Address, P2094, The Engineer Office. P2094 B

TRACER SEEKS POST, Perm., Temp., or Single tracings. Excellent experience and references, engineering, shipbuilding, electrical and construction Terms moderate.—Address, P2114, The Engineer Office. P2114 B

FOREMAN PATTERNMAKER, 9 Years, Foundry and patternshop manager 2 years, DISENGAGED, modern machine methods, P.W. or D.W. estimating, extensive exp. internal combustion, steam, pumps, general, excellent refs.; age 35.—Address, P2106, The Engineer Office. P2106 B

ERECTOR, Wide Exp., Home and Abroad, Ventilating, air conditioning, forced and induced draught, preheaters, boiler-house plant, pipe lines, conveyors, &c., WANTS WORK; would contract for erection.—Address, P2120, The Engineer Office. P2120 B

PARTNERSHIPS.

CONSULTING ENGINEER REQUIRES ACTIVE, HARD-WORKING PARTNER to Assist in and Expand established and progressive practice. Qualifications :—Experience of Contract Work, Mechanical, Civil and Electrical, in Food Factories, or the like. Must have connection sufficient to guarantee salary and expenses within two years. Capital £750.
Age about 35-40.
Bankers' or Solicitors' references exchanged.
Address, P2101, The Engineer Office. P2101 C

AGENCIES.

WANTED, AGENTS, Calling on or in Touch with engineers, to Sell a Quick-drying varnish (black) paint. A good sound article.
For terms, &c., address 8213, The Engineer Office. 8213 D

AGENT WANTED in London District by Reliable Firm of Engineers in Midlands, to obtain inquiries for Grey Iron Castings, also Machining.—Address in confidence, stating full particulars, P2066, The Engineer Office. P2066 D

ENGINEER (40), A.M.I. Mech. E., Experienced in power stations, gasworks plant, oil processes, materials handling, &c., OFFERS efficient LONDON REPRESSENTATION on part expenses basis.—Address, P2074, The Engineer Office. P2074 D

ENGINEER SALESMAN, Good Connection London, oil, mining co.'s, &c., OPEN to CONSIDER AGENCY for Manila Ropes, &c.—Address, P2112, The Engineer Office. P2112 D

SWEDISH FIRM, Limited Company, Established 1901, with excellent connections to all branches of Swedish industry, SEEKS AGENCY for technical article or material for production already well introduced in Sweden, in order to make better use of its organisation.—Reply to "QUALITY-RESULT," Gumaelius Ann Buro, Stockholm, Sweden. 8195 D

MACHINERY, &c., WANTED.

WANTED, SECOND-HAND ELECTRIC FIXED CRANE for One-ton Lift with fixed or luffing jib, about 18ft. radius for use on 400 volts D.C. supply. Give full particulars.—Address, 8199, The Engineer Office. 8199 F

SECOND-HAND REDUCING GEAR, 30 to 1, Transmitting 2 horse-power, 1in. in, 2in. out.—J. J. WILLIAMSON and SONS, St. Mildred's Tannery, Canterbury. P2117 F

For continuation of Small Advertisements see page 4.

Leakproof joints—*and no doubt about it!*

Jenkins '96 sheeting makes assurance doubly sure. Use it and you can be free from all worries about leaking joints.

Jenkins '96 is so made that once in position it becomes as durable as the flange itself. For many years recognised as of the finest quality and thoroughly reliable under all extremes of pressure.

Jenkins '96 is equally satisfactory for saturated steam, hot or cold water and other liquids. It is supplied plain or with brass or steel wire insertion.

Write for free working sample and our **80 pp. catalogue.**

JENKINS BROS. LTD. (Dept. K)
6, Great Queen Street, Kingsway, London, W.C. 2.
Telephone: Holborn 4106. Works: MONTREAL, CANADA.

'96 TRADE JENKINS MARK '96

A Seven-Day Journal

Locomotive Economies on the L.M.S. Ry.

IT is announced that the London, Midland and Scottish Railway Company has placed orders for 130 new steam locomotives, to be built at Crewe and Derby during the year. These orders represent the continuation of the company's policy of standardisation. Since 1923 the number of different types of locomotives has been reduced from 393 to 261. It was in 1926 that Sir Josiah Stamp introduced a new system of locomotive records which provided for the exact measurement of locomotive performance, together with accurate costs of coal consumption and the maintenance of the parts of each locomotive. This system has proved most useful as a guide to locomotive construction policy, and invaluable for the investigation of traction costs, as well as for securing the maximum economy and ability to meet traffic demands. Standardisation of renewal work has contributed materially to the 12½ per cent. reduction which the company has made in its locomotive stock, namely, from 10,316 in 1923 to 9032 at the end of 1931; meanwhile the average tractive effort has risen by 12 per cent. Better organisation and the fact that the newer locomotives can run larger mileages per day, as, for instance, from Euston to Carlisle, Crewe to Glasgow, or Carlisle to Aberdeen, has released for other work as many as 250 engines, while a contributing factor to the smaller total number required has been the reduction of locomotives under and awaiting repair at any one time. This number fell to 383 in 1931, compared with 1958 in 1923, representing a saving in capital lying idle of many millions of pounds sterling. Thanks to standardisation and the progressive system of repairs, the time during which a locomotive is under repair has actually fallen to only six days for more than half the work.

The Manchester Ship Canal.

THE report of the directors of the Manchester Ship Canal Company for the year ended December 31st, 1931, which was issued at the end of last week, shows that the general depression in trade caused a fall in the revenue and weight of traffic borne, but that it was possible by making economies in all departments to reduce expenditure by £52,735, as compared with that of 1930. The net receipts of the whole undertaking, including the Ship Canal and the Bridgewater Canal, amounted to £721,151, which, together with miscellaneous receipts, rents, interest, &c., made a total of £758,117. The miscellaneous charges, including chief rents, wayleaves, &c., rent of grain elevators, docks, and transit sheds, required £114,873, leaving the net revenue of £454,975, which, after providing for loans and debenture stocks, left £216,459 available for dividends and reserve. The sum of £30,000 has been set aside for contingencies and repairs and £31,804 will be carried forward. As to improvements to the canal, the report mentions that the construction of an additional oil dock at Stanlow, Ellesmere Port, and a new wharf and lay-by at the Irlam works of the Lancashire Steel Company is well advanced. Several alterations to the company's railway connections are taking place, and a barge berth with reinforced concrete jetties and road access to the mill has been constructed at the new provender mills of R. and W. Paul, Ltd., at Manchester Docks.

Gas for Road Vehicles.

IN the course of his chairman's address to the shareholders of the Tottenham and District Gas Company on Tuesday last, Mr. Henry Woodall referred to the use of compressed gas for the propulsion of road vehicles. In Paris, he said, much progress had been made and there were numbers of cars then running on compressed gas. The company's engineer, Mr. Smith, had examined the French system and written a full report upon it. That report stated that the vehicles ran very well and that the drivers preferred gas to petrol. In view of that report the company had decided to obtain cylinders for experimental purposes, and he hoped that it would soon have gas-driven lorries in operation. It was, he added, at first feared that the cylinders would have to be purchased in France, but he was glad to say that it had been found possible to obtain them in this country. He believed that the possibilities of the system were great. If the bulk of the omnibuses in London were run on gas no less than half a million more tons of coal would have to be carbonised every year—"a matter of some national importance." Mr. Woodall gave the convenient figure that the gas produced from 1 ton of coal was equal, approximately, to 50 gallons of petrol.

The Mersey Tunnel.

AT a meeting of the Mersey Tunnel Joint Committee, held in Liverpool on Thursday, February 18th, the statement was made by Sir Thomas White, the Chairman of the Committee, that the total cost of the tunnel including the necessary ventilating plant will probably amount to between £6,000,000 and £7,000,000, or about £1,500,000 more than the original estimated cost of £5,222,000. The heaviest item in the increased cost is that of ventilation. About £60,000 was originally set apart for this purpose, but it has since been found that in order to install an efficient system which will ensure the expulsion of the exhaust gases of motor vehicles using the tunnel, a sum of about £1,000,000 will be needed. This sum will, of course, include the fans and their driving machinery, also the concrete inlet and outlet ducts, together with the necessary land and fan houses on either side of the river where the ventilating shafts will be placed. An increase of £500,000 has also been found to be necessary owing to certain changes in the sites of the tunnel entrances on both sides of the river, and the more valuable properties thereby involved. The Committee has had the question of expenditure under careful examination since the work was begun in 1929, and it has decided to make representations to the proper Government Department on the financial questions involved and the possibility of a further grant from the Ministry of Transport.

A New Thames Pleasure Steamer.

ON Wednesday, February 24th, there was launched from the Birkenhead Yard of Cammell, Laird and Co., Ltd., a new paddle steamer, the "Royal Eagle," built to the order of the General Steam Navigation Company, Ltd., London, for its service on the Thames between London, Margate and Ramsgate. The principal dimensions of the vessel are: Length between perpendiculars, 289ft. 9in.; breadth moulded, 36ft. 6in.; breadth, extreme over sponsons, 68ft. 10in.; depth, moulded to main deck, 11ft. 6in.; service speed, 17½ knots. She has a straight stem, cruiser stern, two pole masts, and a single funnel, and is designed to carry more than 2000 passengers. The propelling machinery comprises a triple-expansion engine arranged diagonally, and steam is raised in two single-ended return-tube pattern cylindrical marine boilers, which are designed to burn oil fuel under the closed stokehold system. The auxiliary machinery is of the most modern type. Both the design and construction of the vessel have been carried out under the personal supervision of Mr. William Gray, the owners' consulting naval architect and marine surveyor.

Electric Lighting in Coal Mines.

DISCUSSING a system of coal face lighting by means of magnetic induction at a meeting of the South Staffordshire and Warwickshire Institute of Mining Engineers, held at Birmingham on Monday, Professor W. Cramp said the only source of illumination that appeared at all possible in coal mines was electric light, but the underground conditions were such as to render safety at the face very difficult to achieve, except by the use of hand lamps, which could not be made to combine adequate illumination with effective portability. Moreover, the illumination was purely local, with all the attendant disadvantages, such as the sharp contrast between light and dark, momentary glare and the constant shifting of the beam. Judging from similar instances above ground, there was no doubt that the ideal arrangement would be one which provided a generous measure of general illumination with the possibility of additional local lights where necessary. It had been contended that a minimum illumination of 0·4 foot-candle was desirable at the coal face, but it was quite evident that no form of miners' lamp yet devised could possiby give that value over anything but a very small area. The problem to be solved was the provision of safe and effective lamps fed from the mains at the coal face. The system of lighting which he proposed involved the utilisation of local induction. Each lamp was connected permanently to the secondary of a small transformer, which would be made active by being placed close to its primary coil, and when the lamp was to be extinguished it would simply be removed from the neighbourhood of the primary coil. No switch would be needed and no circuit broken. It became evident that if a single circuit could be arranged with a transformer primary for each lamp the result would be almost ideal. One twin armoured primary lead would run throughout the lighting circuit and connect all the primaries in series. The voltage across each primary would be the main supply pressure divided by the number of primaries, and the pressure on each lamp could be as low as was necessary to prevent danger.

Telephones in the Birmingham District.

A REPORT on the progress of the telephone service in the Birmingham district during the past year, with an indication of future development, has just been issued. At the end of 1931 the district was served by ninety-two exchanges, four new exchanges having been opened during the year, and to meet the increasing demands for the telephone service it was necessary to augment the equipment at thirteen existing exchanges. One of the outstanding features of the year was the introduction of automatic working in the Birmingham area. In March, 1931, the initial stage in the conversion of the whole of Birmingham's telephone system was completed by the change over of the first three exchanges—Northern, Victoria, and Harborne—to the automatic system. The building and equipment of a new automatic exchange at Sheldon was also completed. The economic conditions and general trade depression prevailing during the year were reflected in a reduced percentage growth in the use of the telephone, but a net increase of 3160 stations during 1931 was recorded. During the year the stations working in the district totalled 81,382 and showed an increase of 4·04 per cent. The number of private branch exchanges was 3945 with 30,491 telephones. Residential telephones showed an increase of 1217, and the total number in use at the end of the year was 17,526. To meet the requirements of inhabitants in rural districts twenty-one new rural call offices were put into service during the year. The value of telephone kiosks was fully realised and the number was increased by 689. In the local exchanges 61,151,803 calls were originated in the district, an increase over the previous year of 948,718. The number of trunk calls dealt with increased from 4,437,431 to 4,549,538.

Files and Rasps.

IT is seventeen years since the File Manufacturers' Association last brought into operation a standard list of files and rasps. Certain anomalies and inaccuracies in the list prices of that date have now become apparent, and with a view to correcting these anomalies and at the same time achieving some measure of simplification, British and American file manufacturers have agreed upon a new price list to come into operation on March 1st this year. It is believed that German manufacturers will eventually adopt this new standard list, while manufacturers in Austria, Czecho-Slovakia, France, and Sweden cordially approve of the principle and may in the near future adopt the list, thus making it truly international. It was felt that a large number of the sizes which appeared in the 1915 standards were redundant and unnecessary. For this reason the sizes included in the new list have been reduced in number. For instance, the number of sizes of flat, hand, half-round, square, and round files included in the new standards is nine only, compared with thirty in the old list. The number of three-square files has been reduced from thirty to eleven. From an examination of the new list we find that it does not differ materially, as regards prices, from the old one, save in those few cases where anomalies have been corrected. No undue disturbance of the file and rasp market is therefore likely to result when the new standards come into operation next week.

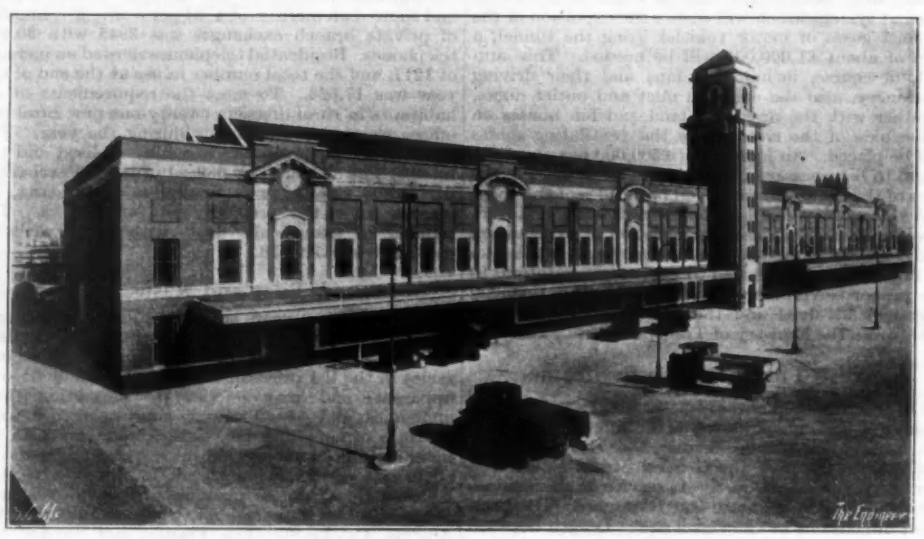
Selby Swing Bridge.

BETWEEN 6 p.m. on Saturday, February 20th, and 11.30 p.m. on Tuesday, the 23rd, repairs were carried out by the London and North-Eastern Railway to the swing bridge at Selby. This bridge carries the railway over the river Ouse and forms the intersection point of two main lines—London-Edinburgh, in the north-south direction, and Hull-Leeds in the east-west direction. To carry out the necessary repairs the bridge had to be closed temporarily and alterations had to be made in the running of no less than 200 trains. The bridge was built in 1890, and, after forty-two years' continuous service, it was decided that certain parts were not sufficiently strong for present-day requirements. One of the fixed spans was entirely removed and replaced by a new span. For this work electric welding was used. Repairs to the swing span comprised work upon the south main girder and renewal of a cross girder and apron plate with rail trough bearers, all of which had suffered from wear. Some of the hydraulic machinery by which the bridge is operated had to be removed before the above-mentioned work could be tackled. The work at the north end of the swing span was not so extensive, as the end cross girder on that side had suffered less damage, for some unknown reason, than that at the southern end. The weight of the new steel work is about 8 tons, and the greatest care had to be taken in its preparation, since it was necessary, in order to avoid undue delays, that each new part should fit accurately when placed in position. On the completion of the work the bridge was re-balanced on its centre, for which purpose several tons of kentledge were needed.

The U.S. Airship Akron.

FOR some time past statements have been in circulation in America concerning the structural soundness and airworthiness of the United States naval airship "Akron." These statements recently received official notice, and a Committee of Congress was appointed to make inquiries into them. On Monday of this week the Committee visited Lakehurst for the purpose of flying in the vessel over New York. Just after the airship had been taken from its shed it was caught by a strong broadside gust of wind and wrenched out of the control of the ground crew. It rose 20ft. in the air and then descended heavily to the ground. One of the fins and other portions of its structure were damaged, and a considerable part of its fabric covering was torn. The Congressmen had not embarked on the vessel at the time of the accident, and escaped injury, but two of the ground crew were caught by the trailing ropes and were badly injured. The airship has a helium gas capacity of 6½ million cubic feet and was built by the Goodyear Zeppelin Corporation at a cost of a million pounds. We illustrated and briefly described it in our issue of January 8th this year. A sister ship is now under construction.

STANLEY ABATTOIR—DEAD MEAT MARKET



New Abattoir at Liverpool.

THE new Stanley Abattoir and Meat and Cattle Markets at Liverpool were formally opened by Lord Derby on September 14th last. In the abattoir, which is probably the largest owned by a municipality in the world, is now concentrated the whole of the slaughtering of cattle, sheep, and pigs in the Liverpool area, all pre-existing private slaughter-houses being closed. The establishment is a municipal enterprise, but the Corporation does not undertake any of the slaughtering or preparation of the meat, those operations being entirely performed by the owners of the beasts, but, as we shall show, cooling and chill rooms are provided.

The site chosen for the erection of the buildings lies about 3 miles east of the Town Hall, and it covers, in addition to adjoining lands, the position formerly occupied by the old Stanley Cattle Market, which was built a century ago. The new cattle market has accommodation for 2250 head of cattle, for 5000 sheep—including the space available in the lairages—and for 2500 pigs. The lairages have been designed for long-period use, arrangements having been made for feeding the animals. The capacity of the lairage unit and waiting pens is 1000 cattle and 940 sheep.

For the operation of the abattoir, the design is based on the general desire to bring about the slaughtering of animals in the most humane and hygienic manner, while not removing it far from that employed in ordinary trade practice in the area.

GENERAL DESCRIPTION.

The total area of the site is about 17 acres, and the land at present taken up by buildings, roadways, and railway sidings is some 12 acres. The construction of the buildings is, generally, of steel framing, with 9in. and 14in. brick panelling between the stanchions, reinforced steel fabric concrete floors, and basement retaining walls of concrete reinforced by steel rodding. Special attention was paid to the protection of the building materials against the attack of ammonia fumes, steam, blood, and water.

The lay-out of the establishment is shown in the accompanying drawing—Fig. 1. The animals—whether cattle, sheep or pigs—destined for the market, arrive at the L.M. & S. Railway Company's siding on the north boundary of the site—that is, at the top of the plan. The road transport facilities include seven outlet doorways to a covered loading verandah on the south side of the dead meat market, all loading being operated from an overhead rail system, which is equipped with weighing machines. An open space, having an average width of 135ft., which has a weighing machine office at each end, has been formed at the south front of the dead meat market for the working of road vehicles. Facilities for the transport of meat by rail are provided on the east boundary of the site. They comprise a double-line railway siding, operated by the L.M. & S. Company, and two covered platforms, one for inwards and one for outwards loading, the outwards platform running to the north boundary of the site.

THE MAIN SLAUGHTER UNIT.

The main slaughter unit—see Figs. 2, 3, and 4—for cattle and sheep, is 270ft. long and 72ft. wide. It comprises waiting pens on the north side with thirteen slaughter booths on the ground floor, two of which are devoted to Jewish slaughter, and further slaughter booths on the first floor, one being for Jewish slaughter, all being complete with dressing stations, cooling rooms, offal disposal chutes, and blood-catching pits for tray and tank collecting systems. An offal-collecting basement runs under the whole length of the slaughter portion of the building. It is divided into collecting compartments for the various slaughter booth tenants, and is connected to the upper floors through stink locks by lifts and staircases. Two offal ramps lead to an offal-clearing station on the north-east corner of the site. The blood-collecting tanks are arranged in a centralised recess, adjoining which is a pump chamber for ejecting the floor surface washings into skim tanks in the boiler-house block, to which we refer later. In the slaughter and cooling rooms the walls are faced in terrazo to a height of about 7ft., above which they are rendered to the ceiling with smooth white cement. The floors are finished in hand-laid lithocrete asphalt laid to falls. Slaughtermen's lavatory accommodation is placed centrally at the first floor level on the north side. A meat detention room and a laboratory are situated at the south-west end of the main slaughter unit, and there is also a meat detention room in the first floor central bay.

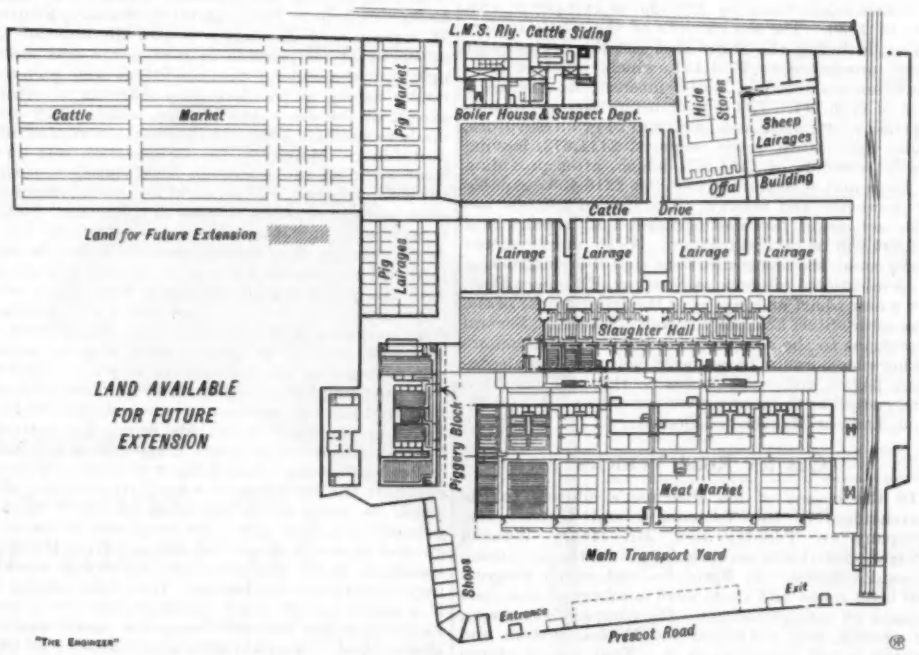


FIG. 1—SITE PLAN

THE CATTLE LAIRAGES.

The cattle lairages are divided into two blocks, each measuring approximately 200ft. by 105ft., each having a centralised ramp which feeds the first floor of the main slaughter unit. Each ramp has a ventilated fodder store under it. The lairages are constructed on the single-storey principle, and are subdivided into a total of twelve separately-controlled units which are fed by the main drive at the north end. Each lairage can be locked off as a separate unit.

THE PIG MARKET AND LAIRAGES.

The pig market and pig lairages Nos. 1 and 2 are at the north end of the piggery building, the pig market adjoining the live cattle market. They are divided into pens fed by drives. The pens are equipped with a water supply, reinforced concrete feeding troughs, and feeding hatches. The floors are finished in hard cement topping laid to falls, and the pens are drained by white glazed floor channels covered with movable cast iron gratings.

THE CATTLE MARKET.

The cattle market building, which is on the north-west portion of the site, covers an area of approximately 415ft. by 210ft. On the north boundary a central space is reserved for the use of the L.M. & S. Railway Company. The building is of the single-storey, louvred, north-lighted type, constructed in a similar matter to the cattle lairages. The sheep market portion is in between the cattle and pig markets, and the pens in it are interchangeable for sheep or cattle. A forage store and a disinfecting chamber are situated at the north-east corner.

An existing lairage building, covering an area of 175ft. by 150ft., at the north-east corner of the site, was reconditioned for the offal station, a portion being reserved for sheep lairages. Storage and cleaning compartments have been arranged for tenants who deal in offal commodities, such as tripe, casings, and hides. Terrazo-finished offal-cleaning tables are placed conveniently near the offal delivery ramps from the basement of the main slaughter unit.

BOILER-HOUSE BUILDING.

Nearly in the centre of the north boundary of the site there is a building, measuring 173ft. by 75ft., which is devoted to several purposes. It houses, for instance, a suspect lairage, including slaughter, hanging and post-mortem rooms and a laboratory; skim tanks for the main slaughter unit floor washings; boiler and calorifier rooms; manure loading bays, &c. The boiler-room contains two Lancashire boilers—for heating and the provision of hot water—an economiser, coal bunkers, &c., and there is a chimney stack 100ft. in height. There is also an incinerator for destroying diseased and condemned carcases, as well as accommodation for blood process treatment.

COOLING AND REFRIGERATION.

The dead meat market and the piggery block are provided with refrigeration services. In the former there are cold stores in the basement for hard meat and ice, while on the ground floor there are chill rooms for sides of beef. In the piggery block there are chill rooms on the ground floor. The stores for hard meat and ice are cooled by cold brine passed through overhead grid pipe coils in duplicate in each store, the main supply pipes being also in duplicate and cross-connected. The brine is circulated by centrifugal pumps from shell-and-tube type brine coolers in the refrigeration plant room. Cooling in the chill rooms is effected by the circulation of air over direct-expansion ammonia wet-air coolers by means of cased centrifugal fans. In the piggery block the chill rooms are cooled by wet air cooling coils and dry coils on brine circulation, which are fed by the main brine coolers in the plant room, cased centrifugal air-circulating fans being arranged inside the chilling chambers.

In the refrigeration plant room, which is on a mezzanine floor over the dead meat market, there are four ammonia compressors of different sizes; two air-cooling batteries, each with a centrifugal fan and brine pump; two shell-and-tube brine coolers; two centrifugal brine-circulating pumps, and three centrifugal condensing-water circulating-pumps. In the same room there is also a brine-concentration plant, which is interconnected with the defrosting circuit of the brine coils in the cold stores. One of the four compressors—the smallest—is used for liquid

cooling and pump-out duty. The other compressors have two, three and four-compressor cylinders respectively, the cylinders in all of them being identical in size and design. Inter-connections are provided on the gas suction and liquid lines, so that any compressor can be employed for duty on any particular load. On the delivery side, the connections are so arranged that each compressor can operate with an isolated section of the condensers, or so that the three compressors can work in parallel with the whole bank of condensers. The compressors are of the single-acting, high-speed type, and the following are their leading particulars :—

Units.	A.	B.	C.	D.
Diameter of cylinders	9in.	9in.	9in.	4in
Number of cylinders	4	2	2	4
Stroke	9in.	9in.	9in.	4in.
Speed, r.p.m.	300	300	300	285
Displacement, cu. ft.	396	298	198	34

Unit A is designed to extract 960,000 B.Th.U. per hour from the insulated chambers when chilling sides of beef from 80 deg. to 38 deg. Fah., over a period of twenty-four hours. That capacity is, as a fact, in excess of present requirements, but it allows for a possible increase in the number of chill rooms. Unit B is designed to extract 720,000 B.Th.U. per hour from the circulating brine when cooling through a range of 10 deg. to 6 deg. Fah., while unit C is intended to extract 480,000 B.Th.U. under the same conditions as for unit B. These compressors are all of the vertical type and the four-cylinder machine is so arranged that the two pairs of cylinders can operate on different suction pressures if required. The three-cylinder machine is similarly arranged for two cylinders and one cylinder, but the two-cylinder machine can only be run on one suction pressure. All the compressors are direct-coupled to self-starting, synchronous motors, each compressor and motor being mounted on one bed-plate. The motors run at 0·8 leading power factor for the partial correction of the lagging power factor of the induction motors used in other parts of the establishment.

As regards the insulation of the cold stores and chill rooms, the floor, outer walls, and ceilings of the hard meat chambers are all covered with 7in. of cork, and the inner division walls with 4in. of cork, all being finished with a minimum of ½in. of cement, and then sprayed with white cellulose paint of a hard nature. The floors, outer and inner walls and ceilings of the pig and beef chill rooms are insulated with 4in. of cork, applied in two layers, the finish being the same as in the hard meat chambers.

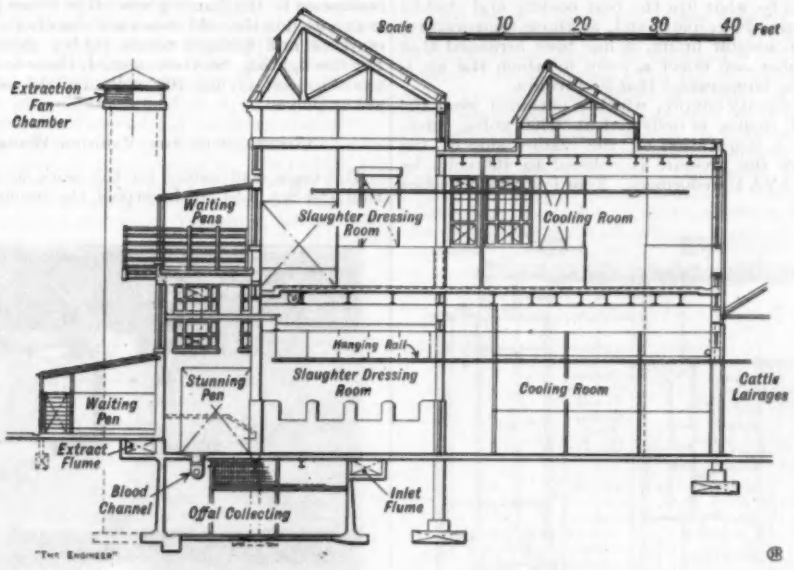
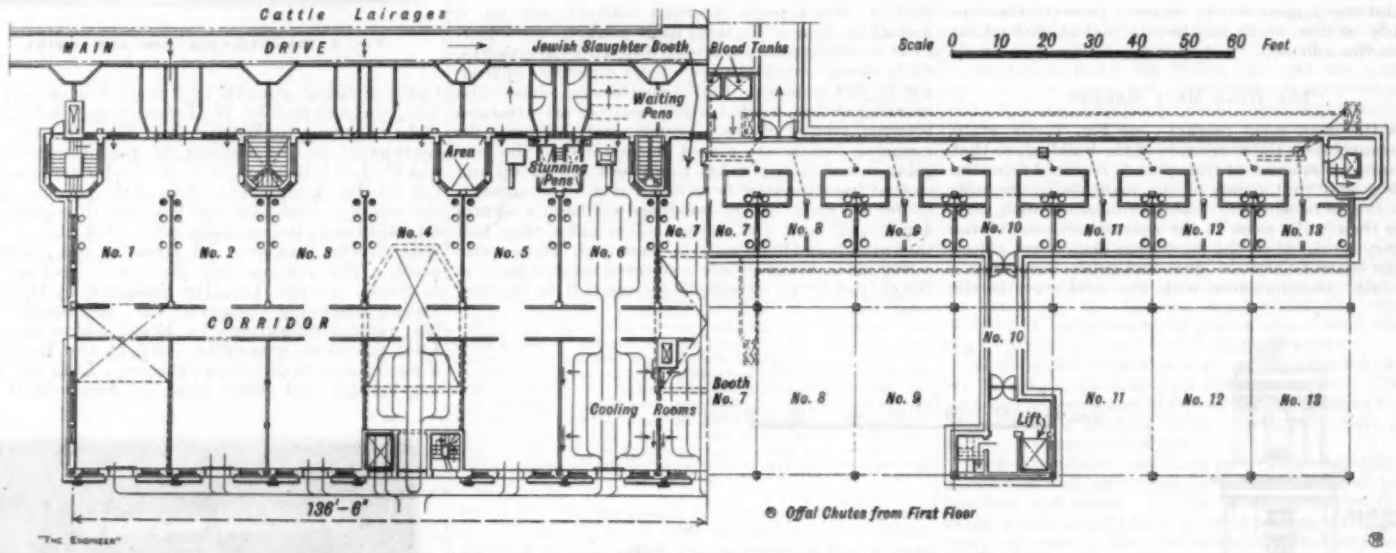


FIG. 2—MAIN SLAUGHTER UNIT—CROSS SECTION

OPERATION OF THE ESTABLISHMENT.

In practice, the cattle are driven from the lairages direct into waiting pens on both the ground and the first floors of the main slaughter unit. These pens are outside the slaughter building, so that the cattle may not be disturbed by the sights and smells inseparable from slaughtering. All the killing stations are furnished with stunning pens, with the exception of those set apart solely for Jewish slaughter, which are differently equipped. After being stunned, the animal is ejected from the pen by the operation of a foot-controlled release, which causes one side of the pen to be drawn up and the floor to tilt, so that the beast falls on its side on the floor. Directly over the place where it lies, is a self-contained direct-driven electric hoist, which is push-button controlled. The animal is shackled round the hind legs, hoisted into the air and moved until it hangs directly over a gush pit, where the throat is cut and the blood falls into the pit. Subsequently, the hoist is moved to a dressing station, of which there are three to each stunning pen on the first floor and two on the ground floor. There, the carcase is lowered to the floor and the hoist taken back to the stunning pen. A hoist, comprising a fixed winding mechanism with a crab running along a rolled steel joist, is provided over the dressing station. By it, the carcase is again hoisted to the required height for the carrying out of the dressing operations, the crab being moved by a traversing motion which is chain-operated for horizontal adjustment of the load. The hoists are driven by gasworks-type squirrel-cage motors. The Jewish slaughter stations are equipped with similar hoists, but the stunning pen is replaced by a Weinberg casting pen, the use of which avoids the possibility of rough handling to get the beast into the required position for the special slaughter.

The offals are dropped through welded stainless steel chutes into the basement, where they are collected and taken to a separate building for sorting and cleaning. This basement is ventilated on the Plenum system, with twenty changes of ozonised air per hour. The passages to the lifts and stairways are, as already mentioned, all fitted with stink locks, and the foul air is extracted and discharged into the atmosphere at the top of the building. The offal and hides department is contained in a pre-existing lairage, which was reconstructed, so that the offal cleaning and sorting can be carried out well away from the other buildings and the products removed direct to the railway siding.



FIGS. 3 AND 4—MAIN SLAUGHTER UNIT—GROUND AND BASEMENT HALF FLOOR PLANS

THE PIGGERY BLOCK.

The piggery block—see Figs. 5 and 6—is, as will be seen from the plan, a separate building. In it only pigs are dealt with. The animals are either driven up a ramp or taken in a lift to the first floor. There they are driven into a Scharmer pig trap, stunned,

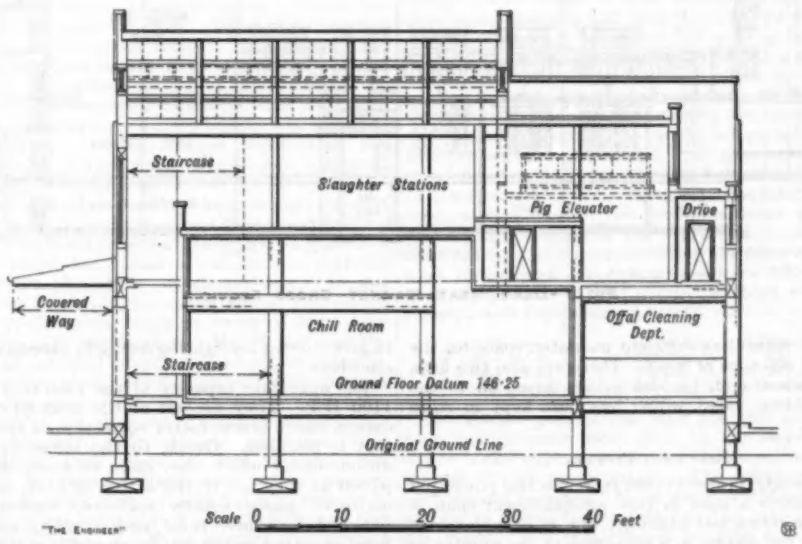


FIG. 5—PIGGERY BUILDING—CROSS SECTION

and then mechanically transported to the sticking and bleeding rails. The carcasses are then dropped into scald tanks. The smaller stations are equipped for hand scraping, but the larger stations have mechanical dehairers of Danish manufacture. These Danish machines are the only foreign articles in the whole scheme, but as we are informed that no British firm makes equipment of the type, it was impossible to avoid installing them. After dressing, during which the offals are dropped below into an offal-collecting department, the carcasses are taken by mechanical de-elevators to the ground floor for cooling and chilling and thence to the dead meat market. The pig market and lairages are directly behind the piggery block, so as to preserve the continuity of flow which has been aimed at throughout the entire scheme.

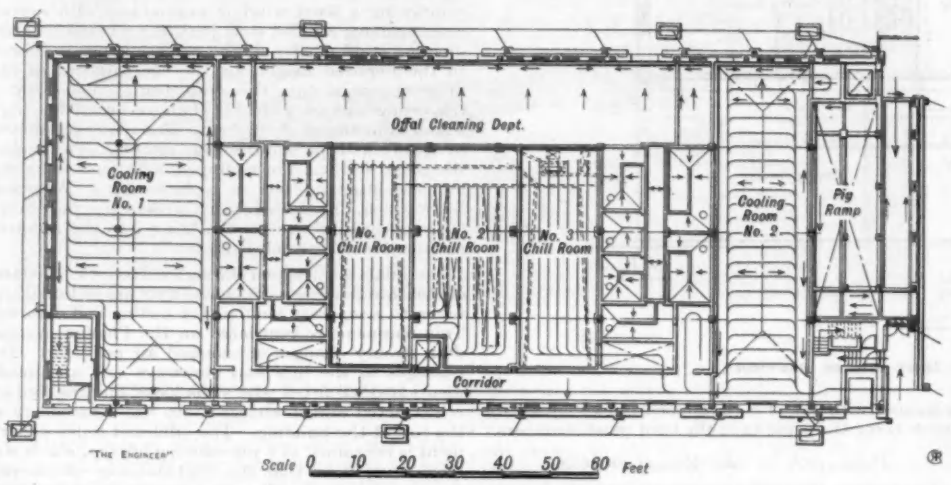


FIG. 6—PIGGERY BUILDING—GROUND FLOOR PLAN

The Dead Meat Market.

In the dead meat market—see Fig. 7—the stalls are arranged on the north side of the building, so that a minimum amount of transport is required from the cooling and chill rooms of the main slaughter unit. The butchers who are mainly concerned with pigs, have their stalls close to the nearest entrance to the piggery block, while the hard meat dealers are placed in the central portion. This last group surrounds a lift that communicates with the cold store in the basement, which has sufficient insulated space for the storage of 500 tons of meat. There are also two lifts, at the eastern end, for delivering, direct on to the railway siding, meat which has been kept in store after sale.

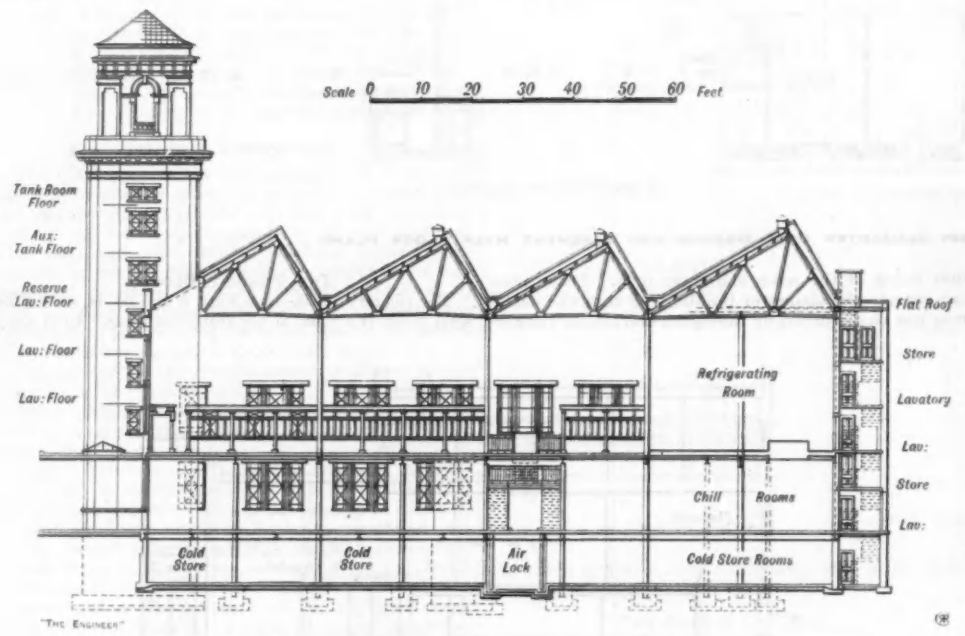


FIG. 7—DEAD MEAT MARKET—CROSS SECTION

Electric Power.

It is thought probable that more electric power per head of cattle is used in this establishment than in any other municipal abattoir, but it is maintained that such use results in a reduction in the number of men required to handle a given number of cattle, so that economy is effected in the long run. Actually, a greater number of electric motors would have been used than are installed, if American meat practice had been followed more closely, but it is pointed out that it is not possible to utilise conveyor systems on a large scale, and at the same time to retain for the English butcher the personal supervision over his meat that he desires. Each butcher has a definite opinion as to what are the best cooling and chilling temperatures to employ, and, as those temperatures fall within narrow limits, it has been arranged that each butcher can select a room in which the air is kept at the temperature that he favours.

The electricity supply, which is obtained from the municipal mains, is delivered at 6000 volts, three-phase, to a sub-station on the eastern side of the site, where the pressure is reduced to 400 volts by three 500 kVA transformers. Four low-tension cables feed a fifteen-panel ironclad switchboard on a mezzanine floor in the dead meat market—see Fig. 7. Four incoming panels can each deal with 750 ampères, while eleven outgoing panels have capacities of from 250 to 350 ampères. Each panel has an interlocked isolating switch, while further isolators are arranged between groups of three panels, and, because two incoming feeders are placed at each end of the outgoing board, it is possible to cut out any group and to feed the remainder from either end. The arrangements are such that all buildings will have a certain amount of light and power unless more than half the switchboard happens to be destroyed. There is also a ring main, but it is only connected up at a point in the pig market by isolating links should it be required to give current for lighting owing to extensive failures elsewhere.

The aggregate capacity of the motors installed is 1100 H.P. They are all of the squirrel-cage type except where power factor correction or speed variation is required. Owing to the unfavourable conditions under which they have to work—being subjected as they are to the action of heat, steam, and corrosive gases—totally enclosed, vacuum-impregnated motors have been used in many cases. The hand-operated switchgear employed is of the ironclad, oil-immersed type, but the contactors are of the air-break type. They are mounted high up and have specially-designed water-tight push buttons. The cable used is mostly paper insulated, but vulcanised india-rubber cables in conduits are used in places where there is only a small likelihood of inside condensation. "Glo-clad" wiring is used for lighting and for small motors in the piggery block and main slaughter unit, since it is considered to offer great resistance to the fumes given off in those places. It is also used in the cold stores and elsewhere, but in the markets and lairages tough rubber cable is used. For the lighting, Scott-connected, three-to-two-phase transformers, giving 105 volts on the secondaries, are employed.

Contractors for Various Works.

The main contractors for the work were William Hall and Son, Ltd., of Liverpool, the steelwork of the buildings being provided by Francis Morton and Co., Ltd., the masonry by W. Thornton and Sons, Ltd., and the glazing by Williams and Watson, Ltd. The contractors for the abattoir equipment were James and Frederick Howard, of Bedford, who were responsible for the supply of the whole of the piggery plant, the runways, both high and low-level throughout the establishment, the stunning pens, offal chutes, offal rails, trucks, carriers, rail trolleys, and accessory plant. The refrigerating plant was provided by L. Sterne and Co., Ltd.; the insulation by the John Davies Insulating Company, Ltd., the heating and hot water arrangements by Edgar Fitton and Co., Ltd.; the steam generating plant by the Brightside Foundry and Engineering Company, Ltd.; the electric lighting and power plant by James Stott and Son, Ltd.; the electric lifts by W. Wadsworth and Sons, Ltd.; and the dressing hoists by S. H. Heywood and Co., Ltd.

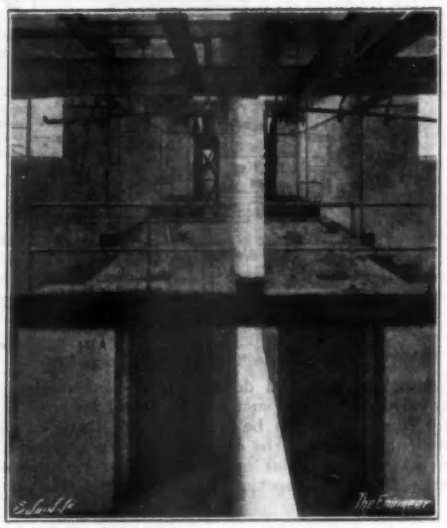


FIG. 8—PIG-STICKING PEN AND HOIST

FIG. 9—NATURAL-AIR COOLING ROOM

Conclusion.

The architectural and steelwork for the scheme was prepared under the Corporation's Land Steward and Surveyor, Mr. A. D. Jenkins, F.S.I.; while the lay-out was designed by Mr. T. Laurie Price, of Messrs. T. Laurie Price and Faulks, consulting engineers, of London, in collaboration with Mr. Jenkins. Mr. Laurie Price was also responsible for the mechanical and other equipment throughout. Reproductions of photographs of various parts of the establishment are given herewith and on page 238.

Institution of Mechanical Engineers.

ON Friday evening of last week the eighty-fifth annual general meeting of the Institution of Mechanical Engineers was held in London. The annual report of the Council showed that during the year there had been a net increase of 155 in the membership roll and that on December 31st, 1931, the members of the Institution numbered 11,161. At the Institution examinations held in April and October in this country and abroad 120 candidates passed the studentship examination and 359 the associate membership examination or portions of it. The Institution now has ten branches, a new one known as the North-Eastern Branch covering Northumberland, Durham, and the Cleveland district of Yorkshire, having been formed during the year. Examinations for National Certificates and Diplomas in Mechanical Engineering were held, in conjunction with the Board of Education, at 115 technical schools and colleges in England. Out of the 2395 candidates who presented themselves for these examinations, 974 and 327 respectively were awarded ordinary and higher certificates and 40 and 37 ordinary and higher diplomas. In Scotland 160 candidates from four institutions presented themselves and succeeded in gaining 94 ordinary and 19 higher certificates and 11 higher diplomas. In Northern Ireland 36 candidates were successful to the extent of gaining 15 ordinary certificates and 1 higher certificate. In conjunction with the Board of Education and the Air Ministry 15 National (Air) Diplomas in Mechanical Engineering were awarded on examination to officers of the Royal Air Force taking the Engineering Course at Henlow.

For the Alloys of Iron Research Committee, a joint committee of learned societies headed by the Royal Society, work was continued during the year at the National Physical Laboratory. The investigation into the constitution of the iron-chromium alloys was completed and a substantial advance was made with the work on the manganese-iron alloys, while an improvement was effected in the production of iron of high purity. It is hoped shortly to begin work on the iron-cobalt alloys and on the iron-sulphur system. The improvement made in the production of pure iron is such that from electro-deposited cathode metal ingots of about 5 lb. weight and of a purity of 99·98 per cent. iron can now be obtained from the high-frequency induction furnace as a routine operation. These ingots can be forged and rolled into rod.

The Cutting Tools Research Committee continued its work. From Mr. E. G. Herbert the Committee received three reports giving the results of his researches in connection with the development of three processes for increasing the hardness of tool steel, namely, the "Cloudburst" process of bombardment with steel balls, a rotary magnetic process and a magnetic stabilising process. From Professor Dempster Smith a report was received dealing with the heat conductivity and hardness of carbon and high-speed steels and on the durability of these steels when cutting brass. The Committee has addressed a questionnaire to firms known to be users of tungsten-carbide tools and is analysing the replies received.

The Marine Oil Engine Trials Committee presented its sixth report dealing with the T.S.M.V. "Polyphemus," on November 20th, 1931. The Committee on Welding under Mr. W. A. Stanier is preparing a questionnaire which will be addressed to the engineering managements of railway, shipping, iron and steel, and engineering companies. For the Wire Ropes Research Committee Dr. W. A. Scoble at Woolwich Polytechnic completed the tests on flattened strand ropes and has carried out additional work connected with the research.

At Manchester University the research on the supercharging of a single-cylinder aero-engine was completed during the year, and a report on the work will, it is expected, shortly be available. At University College, London, an investigation was conducted into the stresses produced by force and shrinkage fits in crank webs and locomotive wheels, and an interim report on the subject has been submitted to the Council. At the University of Sheffield a considerable amount of work was done on the creep of metals at ordinary and high temperatures. It was found that very small rates of creep might continue for many months. Investigations were also made into the effect of long-continued temperatures, such as may be found in plants using superheated steam, and into the embrittlement of metals. It was found that nickel-chrome steels became brittle when subjected to long periods of heating and that intercrystalline effect developed in carbon steels. The results suggest that these steels may again begin to creep after having ceased to creep above certain temperatures.

On the financial side the Institution's revenue for the year was £33,350 6s. 8d. and its expenditure £33,168 13s. 7d.

After the presentation and adoption of the report the Secretary announced the result of the ballot for membership of the Council, and Lieut.-Col. E. Kitson-Clark vacated the presidential chair in favour of Mr. Taylor. The newly elected President, in acknowledging the members' welcome, said that he had been a member of the Institution for thirty-eight years, and for thirty-six of those years he had never thought he would take his seat in the presidential chair. Many years ago he used to read Plato's dialogues. There he found a quotation from Socrates which ran: "That State is best governed in which its governors are least anxious to govern." The quotation aptly expressed his position. A vote of thanks to the retiring President was proposed by Mr. R. W. Allen and seconded by Mr. L. St. L. Pendred.

After the business of the annual meeting had been concluded two papers were presented for discussion. Of these, one by Messrs. W. Barr and W. E. Bardgett, entitled "An Accelerated Test for the Determination of the Limiting Creep Stress of Metals," is reprinted in full elsewhere in this issue. The other paper was by Messrs. R. W. Bailey and A. M. Roberts, and was entitled "Testing of Materials for Service in High Temperature Steam Plant." This paper, running to seventy-five pages of the Institution's "Proceedings," is little short of a text-book on its subject, and all those who desire to study it are advised to consult it in the original. For the time being it is impossible for us to do more than give the following official summary of it:—

Attention is confined to the problem of the behaviour of steels at temperatures now occurring in modern steam-power plant and temperatures of interest in connection with its possible development. The influence of operating conditions by applying a prolonged thermal treatment, which changes the properties and structure of steels, is examined with a view to some provision being made for its action in the testing and selection of steels required for high-temperature service. The case of carbon steels is considered at some length and a general relation connecting the time required to produce a specific change in the microstructure from lamellar cementite to spheroidised cementite appears to apply to these steels as a class. The authors' investigation in connection with this part of the paper embraces cast, forged, and cold-worked steels, also representative superheater tubes from different sources. The influence of working stresses upon the structural change concerned and its rate appears to be negligible, and consequently the results of the authors' tests indicate that within the range of temperature in which they are interested, a short preliminary thermal treatment may be given to carbon steels to produce the effect of prolonged operation in service. Reasons are given for expecting that other steels would behave in accordance with a similar law. An approximate idea is given of the influence of the spheroidisation of cementite in normalised carbon steels upon their creep resistance.

The phenomenon of embrittlement of steels at operating temperatures is referred to and test results are given for a number of different steels. Suggestions are made regarding the testing of steels required for parts such as bolts to ensure the selection of material reasonably free from embrittlement tendency. Attention is given to the subject of tensile tests upon steels required for service at elevated temperatures with a view to the adoption of standard testing conditions. Creep tests are considered and evidence is given showing that this form of test, if properly carried out, can be relied upon to yield similar results in different laboratories. Factors affecting the accuracy of creep-testing equipment are dealt with at some length, and details are given of the authors' equipment designed for refined testing.

The question of how the results of creep tests may be most rationally employed for purposes of design is considered. Results of very lengthy and accurate creep tests under working conditions of stress and temperature are referred to, and it is shown that for working stresses in parts where only small creep is permissible, the total creep during the life of the part may be expected to be appreciably less than that corresponding with the attainment of a minimum rate of creep. Some method of extrapolation from experimental data is unavoidable and the question upon what basis this should be made is examined. The authors suggest extrapolation based upon a specific total deformation appropriate to the particular case concerned and a procedure is proposed for the purpose. Application of the method to a forged steel is given as an example.

Attention is given to the question of shortened creep tests, and suggestions are made both as to the method and for standardising a minimum creep rate for rough comparisons of different materials. Data are given comparing the results of tensile and creep tests and the value of the former as a rough guide to the latter is dealt with. The subject of specification tests for material intended for service at elevated temperatures is discussed.

Opening the discussion on these papers, Professor Lea said Mr. Bailey's work was well known. When he—Professor Lea—had read a paper on the subject many years ago before the Manchester branch of the Institution, Mr. Bailey had asked a very relevant question—how did we know creeping had ceased? Personally, he had suggested at Manchester what was then a new hypothesis that it was possible for a specimen to commence creeping, that at a certain stress it would creep to fracture, and that below that stress it would cease to creep. He had called that stress the limiting creep stress. He believed that Mr. Bailey did not accept that hypothesis. If one examined a curve such as one of those plotted by the authors of the paper depicting what happened to a specimen undergoing a creep test for a long period, the conclusion would be reached finally that the specimen had ceased creeping. The authors suggested that it might be creeping at 10^{-15}in. per inch per hour, but if it was nobody would live long enough to see it break! The authors of the second paper used limiting creep stress in another sense. It appeared that they had determined the stress at which the material would behave almost in an elastic way. It was important to know whether material that had ceased creeping would again begin to creep if kept long enough at a high temperature. Mr. Bailey and Mr. Roberts had focussed attention upon spheroidisation. That effect took place very rapidly with certain types of steel tubes upon which cold work had been done. Spheroidisation did alter other qualities of materials very considerably. Mr. Bailey suggested that spheroidisation took place at low temperatures. Personally, he thought there were other changes, and that those changes were associated with embrittlement. There was a possibility of embrittlement due to structural changes and those changes also affected the problem of creep. He considered that three things required research, viz., embrittlement, what limiting creep stress really meant, and the effect of temperature upon the structure of the material.

Mr. Shannon asked if Mr. Bailey could state whether or not spheroidisation was accompanied by a reduction of the Izod value and differences in the results obtainable from other recognised tests? He would like to refer to an aspect of embrittlement mentioned at length in the paper. He noticed there that the impact resistances of the specimens had been taken cold. He thought it strange that in a paper on high-temperature tests no impact results in the heated state were given. Papers read before the Iron and Steel Institute had shown that impact values varied with the temperature. He instanced some tests on identical bolts taken from the same joint in which the Izod results, cold, varied. Those facts seemed to indicate that the stress to which they were subjected had some influence. Was impact a true measure of embrittlement? Was there any evidence at service temperatures of failure due to embrittlement? As far as bolts for service conditions were concerned, did the authors consider preferable those of high yield and low ductility and aim for stiff bolts and flexible flanges? Power station engineers would be interested in the views of the authors that the creep to be expected in parts where operating conditions were intermittent would be substantially the same as for continuous operation for the same total period. There were other effects in power stations, however. There was vibration, for instance. Was it possible that vibration might induce greater creep rates?

Mr. Schuster mentioned that when superheater tubes failed they exhibited a spheroidised structure. Since metallurgists believed that spheroidisation only took place in a certain belt of temperature, he considered it a remarkable fact that superheater tubes had that structure. With regard to embrittlement, he suggested that the authors might have extended their researches to wrought iron and steel bolts as standards for comparison, and he inquired whether if the loading was intermittent the creep rates were the same as for constant loading.

Professor Haigh believed that to-day all the signs pointed to the fact that the effects of creep, of embrittlement, change of Brinell hardness and other items were all due to one and the same cause, correctly named by the authors as the same as the cause of temper brittleness. If a single cause underlay all the effects it would be very strange if it did not show in the tensile test. Mr. Bailey had sent him a year ago two test pieces, one embrittled and the other not, and asked him whether he could detect any difference in the tensile results. It was important to notice that there was no significant difference as far as the ordinary tensile test was concerned, except in two respects. Though the yield points were the same the tough specimen showed a lower limit of proportionality at 32 tons against 48 tons per square inch for the other, while there was a difference of about 5 per cent. in the contraction of area after breaking. The fractures of the two specimens were very different, one showing the familiar cup, whilst the other, embrittled, had a markedly jagged appearance which any experienced tester would recognise at once.

Mr. Batson criticised the authors of the second paper for describing an American testing machine. There *were* English machines of the same type. Many people believed in a limiting creep stress, although Mr. Bailey, it appeared, did not.

Professor Coker said that very large crystals of aluminium had been made by a combination of temperature and stress. All the experiments described in the second paper utilised a combination of temperature and stress. Had the authors found any such crystallisation occurring in their specimens?

Mr. Tapsell said he was interested in the crystalline fracture of metals at high temperature to which a small reference was made in the second paper. He was very glad that reference had been made, because he thought that was the most important factor with metals under stress at high temperatures. He had examined some wrought alloy steels at 550 deg. Cent., and found such types of fracture, *i.e.*, grain boundaries weakening and material failing by cracking round the grain boundaries. Such fractures might not be found in the refined experiments of the authors. He thought it was necessary in testing for creep to have the stress high enough to cause failure, so that the fracture could be examined. He gave some figures obtained at the National Physical Laboratory referring to the effects of spheroidising a normalised 0·10 per cent. carbon steel. The first specimens were cold drawn and annealed at 650 deg. Cent. for six hours, which spheroidised the cementite. The other specimens were normalised. Temperatures were taken which gave creep rates of 10^{-5} strain per hour at various stresses with the following results:—

Stress.	Annealed.	Normalised.
3·5 tons per sq. in. ..	526 deg. C. ..	545 deg. C.
2·0 tons per sq. in. ..	568 deg. C. ..	587 deg. C.
1·0 tons per sq. in. ..	618 deg. C. ..	638 deg. C.

Mr. Parker pointed out that the test on 0·5 per cent. molybdenum steel given in the second paper might make engineers consider that steel unsuitable for use at high temperatures. The conditions, however, should be noted. No attempt would be made in service to stress the material at the rate shown in the paper. The proportional limiting stress of the material at 550 deg. Cent. was between 7 and 9 tons per square inch, and it was quite inequitable to apply 14 tons per square inch A lot of time was wasted owing to the fact that high-speed tests were neglected

as a means of rapidly sorting out useful and useless materials and for the purpose of selecting a rational stress or series of stresses to employ in the long-period creep tests. A lot of money was spent and time occupied upon creep tests impossible in the commercial sense. He was somewhat surprised that the authors had been able to deduce a law respecting the rate of coalescence when the number of variables was considered, and he suggested that the law might have to be modified in accordance with the material under investigation.

There was not sufficient time for the authors to reply to the discussion, but Mr. Bailey paid a tribute to the co-operation of all those who had assisted him in preparing the researches, the results of which were given in the paper.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

AS I SEE IT.

SIR,—Since the war I have had the pleasure of escorting scores of visitors from Britain through the various factories here and helping them to collect data they wished to take home with them.

The attitude of these gentlemen is impressive because it is so uniform. At first it appears as the natural awe of the stranger seeing new things, or seeing old things in a new environment. On close observance, however, one is led to believe that their wonder arises not so much from what they see as from what they heard before they came.

Influenced very much by THE ENGINEER and other kindred magazines in Britain, I came here thirty years ago to enlarge my experience, and I readily recognise in these visitors the feeling I had then—the feeling of inferiority.

Much has been written and said in regard to the systems and comparative degrees of efficiency in Britain and and America. Comparisons in this, as in so many other subjects, do not compare, and the effort is usually fruitless. There is one point, however, very patent to those who have seen them both at close range, and that is that human ability is very much average the world over.

My last thirty years have been spent here among the shipyards, railways and steel fabricating concerns familiar to readers of THE ENGINEER, and that time is sufficient to meet associates enough from all parts of Europe to learn that no nationality has a monopoly of brains.

It is accepted as a fact that the machine has been developed to a higher degree in America than anywhere else. This is so, of course, because it had to be. In the transition from an agricultural to an industrial country there was not time to develop generations of skilled mechanics similar to those of Europe. The machine was the alternative. This gave the tone and colour to American industrial life and explains much of the unscrupulousness with which it has often been charged. Many of these charges were not exaggerated, but it is a long step in a short time from these methods to the high standards that obtain to-day.

The most brilliant truth that America is assured of is that there is no limit to the accomplishment of a day's work. In pursuit of this ideal some extraordinary things are done, so extraordinary, in fact, as to make the average Britisher gasp.

This American trait of taking a chance is responsible for more progress than anything else in its make-up. All their success is the result of trial and error, and they are never embarrassed by error, if they do not make the same error twice. When this view is appreciated in its relation to the one of restricted output as expressed by many in Britain, many of her problems will solve themselves.

What I wish to "get across" is that there is no need for anyone to spend money to come here, as much can be learned at home and in a way that fits better. The natural resources are greater here, but the unmixed national devotion of Britain can offset this, and while the superlative adjective is used more on this side, the comparative is just as eloquent if the real effort is behind it.

From the make-up of this letter it will be readily seen that it is not a literary effort, but the assurance of experience that anything that can be done in America can be done as well in Britain despite reports to the contrary.

THOMAS COLLINS.

Barberton, Ohio, U.S.A.

PROFIT-SHARING.

SIR,—For the sake of clearness, a few remarks seem desirable on two points in the letters of Mr. Mundy and Mr. Schove in your last week's issue.

Mr. Mundy dismisses the failure of profit-sharing at the Whitwood Colliery of Henry Briggs, Son and Co., as due to "misunderstanding." The somewhat lengthy details of the experiment found in the books of N. P. Gilman and Sedley Taylor suggest that the spirit underlying the proposal was not of the right kind. The history of the colliery up to 1865 is one of fierce and bitter antagonism to trade organisations. So vehement was the opposition that one man is said to have exclaimed, "All coal-masters is devils, and Briggs is the prince of the devils." The withdrawal of a partner, coupled with heavy losses through the disputes, brought financial difficulties, and, says Mr. Gilman, "in this conjuncture, he [Mr. Briggs] determined upon a radical change of policy. His hostility to the trades unions was undiminished; but he conceived the plan of undermining their influence with his men through the formation of an industrial partnership." Such an atmosphere is not a healthy one for an industrial experiment, and the wonder is not that it failed, but that it should have lasted so long. As one of the workers said, "The thing [profit-sharing] is good, but you know it comes from Briggs, and I have no faith in Briggs."

Mr. Schove's description of the scheme in operation at his works, coupled with his final sentence, shows that his firm is working a premium bonus scheme—a method of piecework—which, whatever its merits, does not come within the accepted definition of profit-sharing. In discussions of the subject the two things had much better be kept separate.

EDGAR D. WARD.

West Wickham, February 22nd.

BRITISH EXPRESS LOCOMOTIVE DESIGN.

SIR,—I read in Mr. Tuplin's article entitled "The Trend of British Express Locomotive Design," in your number of February 5th, 1932, the following remark on the subject of 135 deg. cranks: "But in spite of this the scheme is embodied in the 'Lord Nelson' 4–6–0's of the S.R., the only other example in this country being a solitary 0–6–0 engine of the late N.S.R."

May I point out that this is not correct, as some of the converted "Caprotti Claughtons" of the late L.N.W.R. have 135 deg. cranks. Mr. Tuplin mentions the increased difficulty of balancing with this arrangement. The "Caprotti's" are an interesting problem in balancing, as the weights for each side work out different. Is this so for all 135 deg. crank engines, *e.g.*, the "Lord Nelsons?"

B. S. ARMITAGE.

Longmoor Camp, February 22nd.

[We desire to refer our correspondent to our issue of November 19th, 1926, in which a detailed description of the "Lord Nelson" with drawings was given. In that article the question of balancing was discussed. Actually there is a great difference in the balance weights in the leading drivers—the left-hand wheel having 664 lb. at crank radius and the right-hand wheel only 362 lb. The same difference persists, but to a much less extent, in the other pairs.—ED. THE E.]

SIR,—Mr. C. M. Keiller's letter is a welcome and highly interesting addition to my article on this subject. Mr. Keiller is hardly correct, however, in quoting me as having credited the G.W.R. with the introduction of piston valves. The distinction which the authorities of that railway can claim, is that of having realised, as long as thirty years ago, that the essentials of an efficient express locomotive are high boiler pressure and the ability to work at early cut-off without incurring excessive back pressure. The latter requirement almost demands departure from flat valves, as their concomitant long steam passages are not conducive to free exhaust at high speed. The first G.W.R. 4–6–0's for passenger service therefore had piston valves, but that was only one of many respects in which they departed from conventional practice at the time of their production.

W. A. TUPLIN.

Huddersfield, February 20th.

THE SANDBERG PROCESS.

SIR,—We have read with much interest the article on "Heat Treatment of Rails" in your Supplement, THE METALLURGIST, of January 29th. We would, however, like to point out that the reference to the Sandberg process might lead to the assumption that our process had been pioneered and developed at the Hagondange Works in France. While the Hagondange Works are one of our later licensees, we would like to mention that the process was originally developed by a number of licensees in this country, and actually at the present time the following important steel works have complete installations, viz.: Dorman Long and Co., Ltd., the Cargo Fleet Iron Company, Ltd., the Workington Iron and Steel Company, Ltd., the Lancashire Steel Corporation, Ltd., and in America, the Bethlehem Steel Corporation.

For Messrs. SANDBERG,
C. P. SANDBERG.

London, February 22nd.

Steel Trade of the World.

THE world depression is unrelieved. To some extent it is deepened by the clash between China and Japan and the consequent unsettlement throughout the Far East. The low value of silver in India and the agitators' boycott move against British goods combine to aggravate the trade troubles. Neither the railways nor private concerns are buying much steel or many engineering goods just now. Extremely low prices for agricultural produce, shortage of money for railway construction and shipbuilding, international currency difficulties, and protective measures running right up to the prohibition of some imports in certain countries, render trade revival impossible at the moment. The arrears in railway construction schemes, and the increasing obsolescence of much machinery and many implements and tools will, however, combine to make the world's demand for steel immense as soon as financial and political troubles are half smoothed out.

The high price and increasing scarcity of wood assures many more and greater uses for steel in the future. Only in the case of the United States of America need we expect the high record output and consumption of a few years ago to remain for many years the highest on record. In the rest of the world more and more steel will be produced and used. Meantime, steel makers are having depressing and distressing times. The latest Bulletin of the Federation of Iron and Steel Manufacturers gives a sad statistical story, as follows:—

World Production of Pig Iron in Millions of Tons.

	1913.	1929.	1930.	1931. (partly estimated).
United Kingdom	10·26	7·59	6·19	3·76
Germany	10·73*	13·19	9·54	6·04
France	8·93*	10·20	9·88	8·25
Belgium	2·45	4·03	3·35	3·14
Luxemburg	2·51	2·86	2·43	2·03
Saar	1·35	2·07	1·88	1·52
Total Western Europe	36·23	39·94	33·27	24·74
Other European countries	9·02	9·39	9·47	8·14
United States	30·97	42·61	31·75	18·50
World total, including other countries	77·90	97·23	79·40	55·69

World Production of Steel in Millions of Tons.

	1913.	1929.	1930.	1931. (partly estimated).
United Kingdom	7·66	9·64	7·33	5·18
Germany	11·99*	15·99	11·36	8·36
France	6·86*	9·55	9·30	7·90
Belgium	2·43	4·07	3·42	3·16
Luxemburg	1·31	2·66	2·24	2·04
Saar	2·05	2·17	1·91	1·56
Total, Western Europe	32·30	44·08	35·56	28·20
Other European countries	10·16	13·11	12·59	11·10
United States	31·30	56·43	40·70	26·41
World total, including other countries	75·15	118·30	93·33	69·59

* Present territory.

SHEFFIELD'S SHARE.

It is interesting to note, from the Bulletin tables, that, whereas Sheffield produced only 11·4 per cent. of British steel in 1913, with the armaments industry busy, it produced 15·2 per cent. of the nation's total in 1931, with the armaments industry nearly dead. Obviously, therefore, Sheffield must be making a much bigger percentage of steel for ordinary commercial purposes than before the war, and the other districts must be making very much less. It would only be reasonable to expect Sheffield's percentage to be much less, instead of considerably greater, in view of that city's great output of munitions and munitions steel and naval armaments before the war.

IMPORTS AND EXPORTS.

The Bulletin gives the following figures:—

Imports of Iron and Steel into Chief Producing Countries, in Thousands of Tons.

	U.K.	U.S.A.	Germany.	France.	Belgium with Luxemburg.
1913, monthly average	185·9	21·1	25·0 (a)	14·1	72·9 (a)
1930, monthly average	242·4	42·2	93·6	39·3	55·6
1931 (latest month recorded)—					
October	—	—	—	27·2	—
November	—	33·7	53·1	—	35·3
December	266·9	—	—	—	—

Exports of Iron and Steel from Chief Producing Countries, in Thousands of Tons.

	U.K.	U.S.A.	Germany.	France.	Belgium with Luxemburg.
1913, monthly average	414·1	242·3	517·3 (a)	51·6	129·2 (a)
1930, monthly average	263·1	136·2	372·5	333·7	320·9
1931 (latest month recorded)—					
November	—	53·4	323·1	319·6	312·3
December	175·3	—	—	—	—

(a) Luxemburg included with Germany before the war.

THE OUTLOOK.—BRITISH.

Slight improvement is visible. The announcement of a moderate tariff, tending towards an equalisation of competition, but with imported ore left duty-free, has inspired some renewal of confidence, and there is already increased buying of British steel by finishing industries. Imports are being reduced to some extent. Inquiries from abroad have increased, but business remains difficult and on a small scale because of financial and political uncertainties. Orders placed are mostly of small dimensions, and prices are cut to the bone in the heavy lines. Trade with the Far East, recently expected to pick up, has become further depressed by reason of the war between Japan and China.

Business with Canada has substantially improved, and there is revival of inquiries from South American buyers. Our shipyards display no greater activity, and they are using less steel than for forty years past, with the early prospects still very dark. Revival will come later on when the price of scrap and the level of freights improve. Then we shall see many aged vessels broken up and orders given

out for the most modern economy ships builders can offer, for obsolete vessels cannot be profitable. Our railways have not much money to spend, but they are giving out a few fairly substantial orders, and they are more and more turning from wood to steel for rolling stock and sleepers. Coalowners have little to spend, but there is a pronounced move in favour of steel as a substitute for wood for props and beams. There are fairly good demands for steel for various purposes in connection with electrical undertakings, and there is some sign of seasonal improvement in steel for houses and road vehicles.

FOREIGN CONDITIONS.

United States.—The usual seasonal increase in business is much smaller than normal. Money is extremely scarce and the demands for railway, shipbuilding, and structural steel, for motor car, tool, and implement steels, are all very disappointing. Order books are nearly empty, and some of the biggest steel-making concerns are earning the smallest profits on record, and others are making losses. Over 70 per cent. of capacity is idle. In railway steel there is almost a total cessation of buying. It is remarkable that when the United States demand for steel rails first touched 3,000,000 tons for a year the steel makers completely misjudged the position. They imagined that the rate of increase would continue, overlooking the fact that the country was becoming well supplied with railways and that there must be a decrease in the demand. They rushed up their rail mill capacity to a 6,000,000 tons a year level, and now they cannot sell even 1,000,000 tons a year, home and export combined. The demand for ship steel has slumped from about 6,000,000 tons in 1920 to barely 500,000 tons a year now.

RAIL RATES INCREASE.

A set-back is given to the American export trade by an unexpected advance in railway charges on practically all the fuel and raw materials and all the finished products of the steel industry. The railway companies, verging on bankruptcy, have been granted legal powers to increase their charges by 10 per cent., and as the average hauls for ore, coal, coke, iron and steel, and products are enormous in the United States, the 10 per cent. increase in charges amounts to much more than a similar increase would amount to in our country, where we have short hauls. The average inland transport costs on steel were already three times as high in the United States as in Britain, prior to the increase made a few days ago. America had already lost nearly all her trade in export markets, with the exception of Canada. British steel makers had seriously tackled the Dominion market before the American rail charges were increased. Now the increased charges on ore, fuel, iron and steel, and finished steel products will much weaken the competitive position of American heavy trades, and with our lower productive costs and much lower total inclusive transport charges—inland and ocean—to Quebec, Montreal, and other Dominion ports than the overland transport charges on American steel, we may expect considerably increased trade in Canada against American competition.

FRANCE.

The market is dull. The number of blast-furnaces operating was 135 in January, 1931. The number has fallen to 90. There is still a great volume of business on account of fortifications and other works of a national or public character; naval shipbuilding is active and increased protection is being given to mercantile shipbuilding. The general commercial demand is weaker than for several years past. The producers are endeavouring to form a price maintenance syndicate, but have not succeeded up to the moment of writing. Exports are kept up at a high level—six times as high as before the war—but prices are cut down to unprofitable figures.

GERMANY.

Manufacturers pretend to be disappointed because the proposed international selling syndicate has not been formed to maintain prices. Such a syndicate could not function if it were formed. The Steel Cartel is powerless alike over production, exports, and prices. Pig iron has been reduced in price, but no increase of business has resulted. The inland steel market is very depressed and the export trade, well maintained in tonnage, is unprofitable.

BELGIUM.

A slight improvement which set in a few weeks ago has not been kept up, and business in the home market is depressed. Roughly, current production is one-third below the high record level of 1929, and exports are down by one-fourth. Prices have declined much more, and the Steel Cartel is powerless to control or check the competition it was formed to regulate between the European producing countries. The pig iron and steel prices, regarded as bed-rock bottom several weeks ago, have not so proved, there having been further declines in the second half of January and first half of February. F.o.b. prices* at Antwerp are given herewith :—

	Mid-Jan., 1931.	Mid-Jan., 1932.	Mid-Feb., 1932.
	s. d.	s. d.	s. d.
Billets	72 0	71 0	69 0
Sheet bars..	72 0	72 6	71 0
Merchant bars	88 0	78 0	76 0

Trade with the East has worsened, and competition in the West is intensified. In Germany, France, and Belgium there have been wage reductions in the mining industries, and more are being pressed for by the employers. Fuel is cheaper than for many years, but the fall in iron and steel prices has been still more pronounced, and few firms are making satisfactory profits. There is no visible sign of early improvement. Time and patience are required.

THE official returns rendered to the Electricity Commissioners show that 1162 million units of electricity were generated by authorised undertakers in Great Britain during the month of January, 1932, as compared with the finally revised figure of 1141 million units in the corresponding month of 1931, or an increase of 1·8 per cent.

* 24⅛ Belgas to the £.

Engineering Institute of Canada.

THE forty-sixth annual Convention of the Engineering Institute of Canada was held at the Royal York Hotel, Toronto, February 3rd to 5th, with an attendance of about 400 delegates from all parts of Canada. The election of officers resulted as follows:—President, Dr. Charles Camsell, Dominion Deputy Minister of Mines; Vice-presidents, Messrs. A. H. Harkness, of Toronto, A. B. Normandin, of Quebec, and S. C. Miffien, of Glace Bay, N.S. Councillors: Messrs. J. B. Morrison, of Cape Breton; L. H. Robinson, of Moncton; H. Clinton, of Quebec; F. Newell, of Montreal; J. P. Pratley, of Montreal; J. McLeish, of Ottawa; R. B. Dobbin, of Peterboro; J. J. Trail, of Toronto; F. W. Paulin, of Hamilton; E. C. Cameron, of Niagara; A. E. Pickering, of Sault Ste. Marie; J. W. Porter, of Winnipeg; J. C. McKenzie, of Saskatchewan; J. B. de Hart, of Lethbridge; B. Russell, of Calgary; and F. C. Green, of Victoria.

Mr. C. G. Porter, the retiring President, in his annual address, pointed out that a new outlet for scientific research lay in the conservation of Canada's natural resources. Engineering and science had, he said, been wonderfully successful in their application to industry, and it was possible that a revolution in the field of economics and politics was about to take place. Engineers and men of science should feel it their duty to assist economists and legislators in applying scientific methods in seeking solutions of their problems.

At the luncheon which followed, addresses of welcome were delivered by Mayor Stewart, of Toronto, and Mr. C. S. L. Hertzberg, Chairman of the Toronto Branch of the Institute. Dr. W. Hamilton Fyfe, of Queen's University, was the chief speaker at a dinner held in the evening, at which prizes and medals awarded by the Institute were distributed, as follows:—To Mr. A. W. McQueen, Niagara Falls, the Past-president's Prize for a paper on "Engineering Education"; to Mr. C. O. Vogan, the Gzowski Medal, for his paper on "The Design of the Chute à Caron Division Canal"; to Dr. G. S. Hume, of Alberta, the Plummer Medal; and to Mr. W. S. Dyer, of Ontario, the Leonard Medal, for his paper on "Moose River Lignite Deposits."

An outstanding feature of the second day's proceedings was the presentation of papers by Mr. E. A. Alcutt, M.E.I.C., Professor of Mechanical Engineering, Toronto, and Mr. H. L. Wittek, of Toronto, which dealt with the utilisation of the low-grade fuels of Canada, and the prevention of economic waste in heating. The sub-bituminous coals and lignite resources were, it was stated, estimated at over a billion short tons, and comprised 77 per cent. of the fuel resources of the Dominion. It had been estimated that there was a 19 per cent. waste in the Canadian lumber fields, which could be used for fuel. Those resources which were not at present commercially utilised, would become of much importance with the development of central heating units, and the co-ordination of hydro-electric fuel plants. It was estimated, as an example of waste in the timber industry, that a paper plant using 100 cords would have 22½ tons of moist bark to dispose of, and if it were burned after removing the moisture, the saving as compared with coal at 7 dollars a ton, would amount to 5500 dollars a year.

An interesting paper was read by Mr. Walter Lambert, M.E.I.C., of Montreal, which gave a review of the development of the ferry service established in 1775, between Prince Edward Island and the mainland. The service at first consisted of a fleet of birch bark canoes, but now included one of the most powerful ice-breaking ferries in the world, a triple-screw ice-breaking train and an auto-ferry, the "Charlottetown," which afforded Prince Edward Island a perfectly regular service, even in the worst of winter weather.

The annual banquet was held in the evening, at which an address was delivered by Dr. Hamilton Fyfe, who made a forceful plea for the development of the cultural side of engineering education. Engineering skill, knowledge, and intelligence had, he said, been exploited to the detriment of humanity, not only in the production of armaments which threatened human security, but by men who made fortunes out of massed production of inferior and cheap machinery which tended to fetter the advance of science. Unless the engineer had an opportunity to develop his interest in all the manifestations of the human spirit, he was stunted as a human being, and less effective as an engineer. In the past, the education of engineers had been weak in that respect, because the deans and the professors of the Faculty of Engineering had left it to the Faculty of Arts. Science was solving every problem that industry presented, and yet industry was languishing because engineering was in bondage to finance and there had, as yet, been no attempt to apply the beneficial methods of science to the problems of financial control.

At the closing session the problem of rail and highway competition in transportation was discussed at length. Mr. S. W. Fairweather, Director of the Bureau of Economics of the Canadian National Railways, contended that there was too great a disparity in costs to permit of anything like a complete substitution of motor vehicle for railway service. The bulk of the nation's land transport must, of necessity, remain with the steam railways. Whatever specific damage had been caused by motor competition had been more than compensated by the increased standard of living and the general increase in industrial activity. Mr. R. M. Smith, Deputy Minister of Highways for Ontario, defended the Provincial Government's maintenance of highways on the ground that it was not subsidising the truck and the motor omnibus. The competition of trucks with the railway service was not so serious as was asserted by the railways. It would be unfortunate if officials on both sides could not find some ground for co-ordination. Mr. W. A. McLean, consulting engineer, argued that the railways themselves should co-ordinate railway and highway traffic, rather than appeal for taxation and regulation which would cripple highway traffic.

THE VENTILATION AND COOLING OF TURBO-ALTERNATORS.

IN a paper delivered recently by Mr. D. MacFarlane, A.M.I.E.E., before the Junior Institution of Engineers, reference was made to the difficulties of the problem of efficiently ventilating and cooling modern electrical generating plant as a result of the great increase in size and speed of units. The importance of ensuring that clean air was used for the purpose was emphasised by the author. Ordinary air as taken from the atmosphere in towns contained, he said, a large amount of dust and dirt, which, if allowed to enter the generator might in time destroy the insulation of the windings. Following recent improvements in materials and methods of ventilation, large machines having an efficiency of 98 per cent. could now be built. That gain in efficiency would be appreciated if it was noted that a 100,000 kW unit built on the lines and with the material of earlier machines would require the expenditure of 1500 kW of energy for ventilation, but with the reduced losses in modern machines only 400 kW would be required for that purpose. Nearly all turbo-alternators, Mr. MacFarlane stated, were now ventilated by a closed air circuit, wherein the same air was re-circulated round the alternator after passing through an air cooler. The closed circuit system dispensed with an air cleaner, which was very necessary in the open circuit type. To be efficient the cooling air must reach effectively all sources of heat generation in rotor and stator and the systems known respectively as radial, circumferential, axial or radial axial were described. For large modern machines the multiple-inlet radial axial system was advocated. Whilst air was not the ideal coolant for electrical machines, it was the most simple in application, and in a closed circuit the amount of oxygen available to support combustion if the machine took fire was small, and an internal fire would rapidly be choked down because of the exhaustion of the oxygen. Attempts had been made to use water for cooling, but with limited success. Oil cooling had also been experimented with, and also hydrogen. The cooling of generators during peak loads by means of brine circulation in an auxiliary cooler of an enclosed circuit system was considered, and it was shown that by that means the rating of a machine could economically be increased from 25 per cent. above normal to 75 per cent. The author considered that that principle might be extended, by using the brine method for cooling the alternator locally, and the ordinary methods of cooling to dissipate the heat of those parts in which the losses were independent of the load.

ATMOSPHERIC CONDITIONS IN THE BLACKWALL AND ROTHERHITHE TUNNELS.

THE following particulars regarding the atmospheric conditions in the Blackwall and Rotherhithe Tunnels was recently made to the London County Council in a Report of its Highways Committee:—

"Since 1928 systematic investigations have been made as to the condition of the air in Blackwall and Rotherhithe tunnels. These were continued during 1931. Observations were concentrated on the period about 10 a.m., when the worst conditions had been proved to occur, and practically all the samples of atmosphere were taken at about that time.

"The greater part of the new ventilation plant at Blackwall Tunnel was working throughout the year, and the last instalment was brought into operation at the end of July. The remarkable improvement produced in the atmospheric conditions in the tunnel is clearly shown by a comparison of the results for 1930 and 1931. For the whole year the average carbon monoxide content of the tunnel air was 9·2 parts in 100,000 in 1931, as compared with 21·5 parts in 100,000 in 1930, and only two of the 104 samples contained more than the recommended maximum figure of 20 parts in 100,000, as against thirty-nine in 1930. A similar improvement was shown in the suspended matter content of the air, the 1931 average being 4·0 on Owens' fog shade scale, compared with 6·2 in 1930. The corresponding numbers of samples exceeding the recommended limit figure of 6—*i.e.*, 1·92 milligrammes black suspended matter a cubic metre—were three out of twenty-six in 1931 and ten out of twenty-four in 1930 respectively.

"In the case of Rotherhithe Tunnel, the first portion of the new ventilating plant was only put into operation in November, so that for practically all the year the conditions were the same as those for 1930. Owing presumably to an increase in the amount of motor traffic using the tunnel, the atmospheric conditions were rather worse than those for 1930. The average carbon monoxide content of the air in 1931 was 19·6 parts in 100,000, compared with 16·4 parts in 100,000 in 1930, and forty-one of the 103 samples, compared with twenty-five out of 103 in 1930, exceeded the recommended limit of 20 parts in 100,000. A comparison of the suspended matter figures showed similar results, the averages for 1931 and 1930 being 7·8 and 7·3 respectively, with twenty-one and sixteen out of twenty-six samples in each case exceeding the limit figure of 6.

"All these figures refer to the worst conditions which normally occur in the tunnels. They clearly prove that the new ventilation plant at Blackwall Tunnel has throughout the past year, with rare exceptions, maintained the atmosphere in a satisfactory state from the public health point of view. At Rotherhithe Tunnel the condition of the air has not been so good, but doubtless on the completion of the new ventilation plant now being installed a great improvement will be shown during the current year."

THE new bridge across the Danube on the route from Belgrade to Pancsova has been completed. The bridge is 1500 m. (4950ft.) long and 11 m. (36ft.) wide. It cost 25,000,000 Rmks. (say, £1,250,000 at par), of which two-thirds were found on war reparations account. Seven of the main spans are 160 m. wide (say, 528ft.). It is claimed that the bridge is the longest across the Danube, if not the longest in Europe.

British Industries Fair, Birmingham

No. II.*

W. H. ALLEN, SONS AND CO., LTD.

FROM the extensive display of industrial equipment shown at Birmingham by W. H. Allen, Sons and Co., Ltd., we have chosen for illustration and description two of the larger exhibits: a 200 B.H.P. six-cylinder airless injection oil engine direct coupled to a 132-kW Allen D.C. generator; and a 50-kW turbo-generator set, both examples of the firm's latest designs of power-producing plant. Other smaller exhibits, which we do not illustrate, include examples of Allen Conqueror-Unalow pumps, which are manufactured in standardised sizes with branches from 2in. to 6in. diameter. They are designed to operate at high efficiencies against lifts varying from 15ft. up to 65ft. A speed of 1450 r.p.m. has been chosen for this series of pumps as being most convenient for 50-cycle A.C. supply, but a wide range of speeds for D.C. motors and other forms of drive are also available. The firm is also showing a 3in. unchokeable pump with a relatively high efficiency of 65 per cent., while there are also displayed on the stand examples of Allen foundry practice, including specimens and parts of Allen Perlit iron.

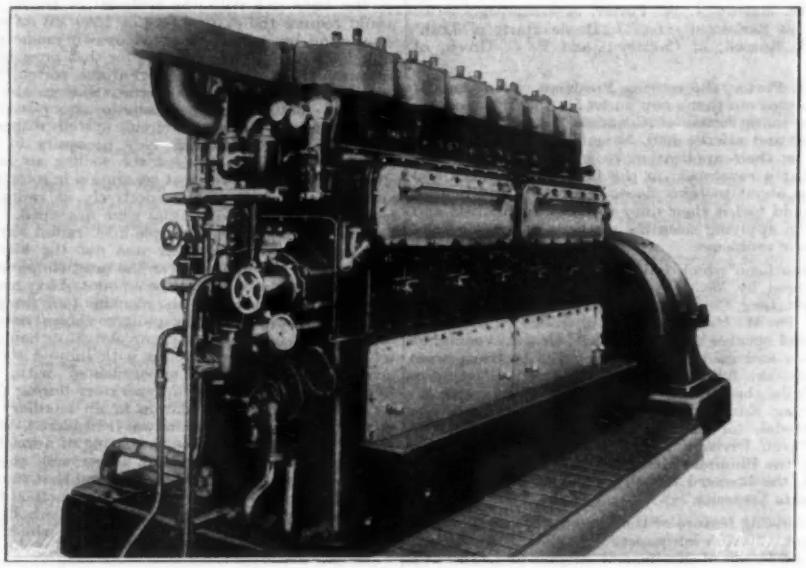


FIG. 6—200 B.H.P. 6-CYLINDER OIL ENGINE—ALLEN

In Fig. 6 we reproduce a view of the 132-kW generator set. The engine embodies the special features of the Allen high-speed airless injection engine which is made in two to eight-cylinder units. These were referred to in detail in the illustrated description of the engine which was published in THE ENGINEER of February 21st, 1930, when we specially described the three-cylinder 100 B.H.P. unit. The cylinders have a bore of 230 mm. with a stroke of 300 mm., and the full output is developed at a normal speed of 500 r.p.m. The engine operates on the four-stroke single-acting principle with airless injection, and the fuel consumption at full load is 0·39 lb. of oil per B.H.P.-hour, the lubricating oil consumption working out at 0·005 lb. The engine has been designed for silent running, and special care has been devoted to the governor and fuel pump control mechanism in order to ensure that exceedingly sensitive governing is available for parallel running of generators.

The illustration Fig. 7 shows the 50-kW turbo-generator set which has been designed as a pilot unit to work in conjunction with a larger generator set. It is of the firm's standard single-stage impulse type with single-reduction gearing totally enclosed and equipped with forced lubrication. To the extreme left of our illustration will be seen a combined stop and emergency valve with overspeed trip gear, which can also be hand operated. Below, on the turbine casing, are the drain valves from the steam chest and belt and the controls for the sealing gland steam and the steam for the ejector on the small water circulating pump which will be seen at the end of the dynamo shaft. This pump supplies water to the oil cooler, which is mounted on the opposite side of the set. Convenient access is provided to the oil strainer in the bed-plate. The bed-plate is also furnished with doors for cleaning out the oil spaces. The set we have described is designed to work at 225 lb. gauge pressure with 150 deg. Fah. superheat, and to exhaust either to a condenser or against a back pressure of 25 lb. gauge. The designed overload capacity of the set is 10 per cent. Since the introduction of the first Allen steam turbine Messrs. Allens have supplied, we are informed, turbines aggregating over 380,000 B.H.P.

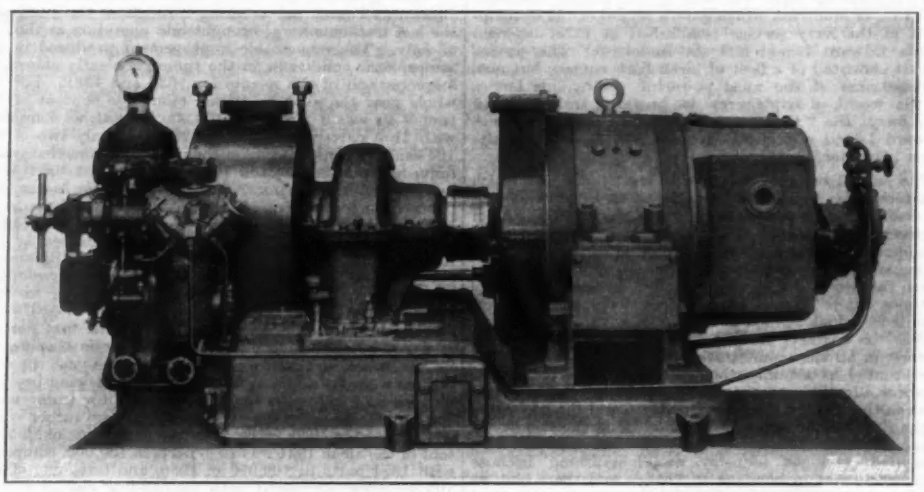


FIG. 7—50-kW TURBO-GENERATOR—ALLEN

* No. I. appeared February 19th.

CROMPTON PARKINSON, LTD.

The exhibits of Crompton Parkinson, Ltd., of Bush House, Aldwych, W.C. 2, consist of A.C. and D.C. industrial motors, fractional horse-power motors, transformers, and switchgear. One of the motors shown is the firm's repulsion induction motor, illustrated in Fig. 8, which has been introduced to meet the demand for a single-phase motor with a good starting torque. It enables ordinary loads to be started without the complications of fast and loose drives or special clutches, and although it has high starting torque, it takes a moderate starting current. Under running conditions it operates as an induction motor, but during the starting period it works as a repulsion machine in the well-known manner. It has a high overload capacity and high efficiency and power factor. As shown in Fig. 9, the armature has a radial commutator. The commutator, short circuiting and brush-raising device shown in Fig. 10 is constructed on robust lines and is said to provide ample force to ensure definite brush lifting and adequate short circuiting of the commutator, and both these operations occur at the proper speed to ensure a correct transfer from the repulsion to the induction condition. The short-circuiting action is obtained by governor weights at the driving end of the rotor, which actuate the short-circuiting and brush-raising gear by means of push rods passing through the core. At a predetermined speed these rods move the short-circuiting contacts into a position where they short circuit the segments on a solid copper ring, the action being obtained by the centrifugal force of the contacts themselves, which have the necessary area to obviate any danger of burning whilst in service. Immediately after the commutator has been short circuited the brushes are caused to lift by the axial movement of a floating ring which engages with the brush-lifting levers. Pressure is first taken off the brushes, which are then raised a definite amount from the commutator. The floating ring is held by special projections on the lifting levers so as to remain out of frictional contact with the rotating portions.

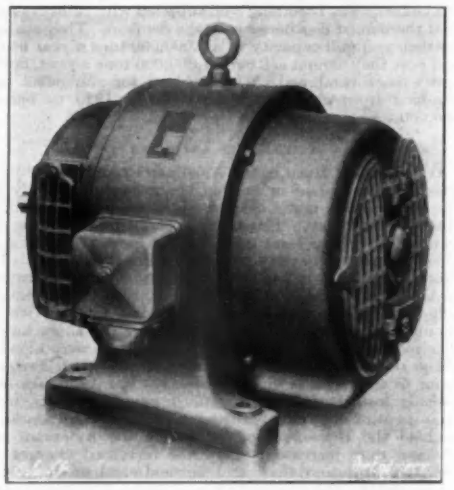


FIG. 8—REPULSION INDUCTION MOTOR—CROMPTON

Motors of this type rated at 1 to 5 H.P. have six poles, and those rated from 1½ to 7½ H.P. four poles. The voltages are 200–250 or 400–500 and the frequencies 40, 50, and 60 cycles per second. To enable the windings to be connected in series or parallel for the higher or lower voltage, four connections are brought out to the terminal box and the change is made by interchanging two connecting links. All machines are built to standard design and machined to gauge so that spare parts are interchangeable. Friction losses are reduced to a minimum by the use of ball and roller bearings. Windage is also reduced to the lowest value consistent with good ventilation, giving the additional advantage of silent running. An ample margin is allowed for overload and temperature rise, in accordance with the British Engineering Standards Association requirements. The terminal box can be fitted on either side of the frame and can be arranged to take leads from above, below, or either side in accordance with customers' requirements. The direction of rotation can be reversed by simply moving the brush rocker to a marked position without changing any connections or making any other alterations. The standard direction for all these motors is clockwise, looking at the commutator end, where there are hinged protecting covers to give easy access to the brushes and commutator. Covers for alternative types of enclosures are available.

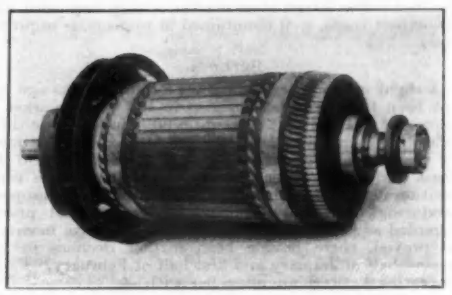


FIG. 9—MOTOR ARMATURE—CROMPTON

The types of enclosures provided are:—(1) Screen protected with cast metal grids made to British Engineering Standards Association requirements, fitted over the openings in the end shields, the covers at the commutator end being hinged and spring fastened; (2) a drip-proof enclosure similar to the above, except

that the covers are louvred and provided with water-tight joints, all falling dirt, dust, or moisture being therefore excluded; (3) a pipe-ventilated enclosure with a flange at the commutator end to take a sheet iron inlet pipe. At the driving end cast metal grids or louvred covers are normally provided and the cooling air is discharged into the atmosphere. If desired, an inlet pipe can be fitted on the normal facings provided on the end shield, but in this case an increase in the frame size may be necessary. (4) A totally enclosed enclosure with hinged doors fitted at the commutator end. At the driving end screwed-on solid covers are provided. All machines

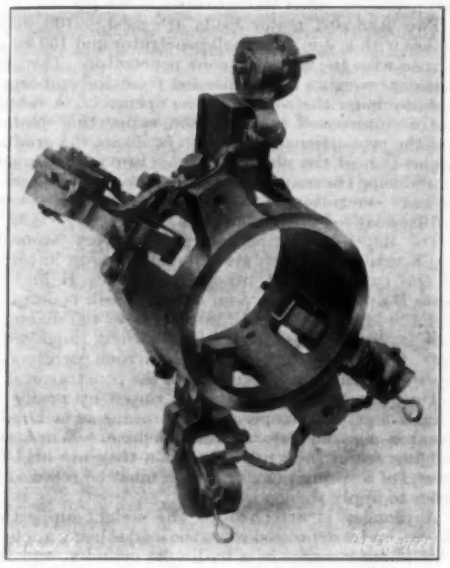


FIG. 10—BRUSH RAISING MECHANISM—CROMPTON

are fitted with roller bearings at the driving end and ball bearings at the commutator end.

G. D. PETERS, LTD.

A new type of "Plastic Arc" welder—Fig. 11—is being shown by G. D. Peters and Co., Ltd., of Windsor Works, Slough. It has been designed to enable any desired current to be obtained within the limits of the machine by the movement of a simple switch and regulator, and a new type of drooping characteristic generator has been developed to work in conjunction with this system of control. Whilst giving the quickest possible recovery and maximum control of current, the machine is said to run at a low temperature, the commutator being the coolest part. It is claimed that the new machine is the fastest on the market and will deposit a greater weight of metal per kilowatt-hour than any other machine. The single-operator demonstration plant exhibited has a capacity of 260 ampères and is complete with the new rotary selector with six positions giving current values of 60, 100, 130, 160, 180, 200, and over. The normal open circuit voltage is 60 and drops to 25–30 volts on load when driven at a speed of 1430 r.p.m. When the open circuit voltage of the generator is set at 60

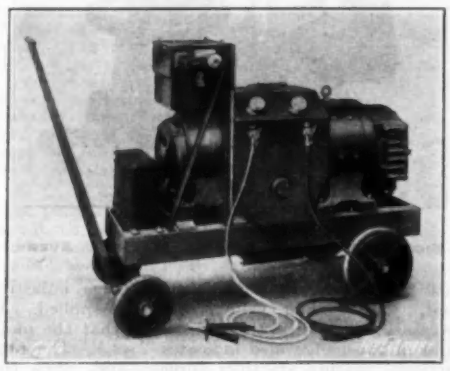


FIG. 11—"PLASTIC ARC" WELDER—PETERS

the welding current corresponds to that indicated on the selector switch, but should any intermediate setting be necessary the open circuit voltage is adjusted to suit, so that actually any current value can easily be obtained between 60 and the maximum of 260 ampères. In order to obtain a welding current below 60 ampères the rotary switch is placed in the 60 ampère position and the open circuit voltage is reduced to give the desired current.

Another demonstration plant is a "Plastic Arc" multi-operator type consisting of a generator having a maximum capacity of 375 ampères at a speed of 1430 r.p.m. Two current control panels are fitted, one for each operator, although when the work is light a third panel may be provided for an additional operator. There is also a portable petrol engine-driven single-operator welder fitted with a Ford industrial engine, and a single-operator 260-ampère motor generator welder mounted on a truck. Besides the firm's "colour-tipt" welding electrodes, some recently evolved, but well tested, general purpose electrodes are shown.

GEORGE KENT, LTD.

There is a novel meter on the stand of G. Kent, Ltd., of Biscot-road Works, Luton, Beds. It is intended for the measurement of dirty gas and is of the shunt type. We illustrate it in Figs. 12 and 13.

An orifice K—see Fig. 12—is placed in the gas main and diverts a proportion of the gas through a shunt circuit arranged above the orifice. In this shunt a turbine T is placed. Gas impinges on the turbine through two diametrically opposite nozzles J, so that there is no side thrust on the bearings. The speed of the turbine is kept down by making it large in diameter, so that the gaseous resistance to its rotation is considerable, and by fitting baffles in the corners of the chamber in which it works. The weight of the turbine is carried by a float M immersed in mercury. This enables strong and incorrodible materials, such as Monel metal or Staybrite steel, to be used in the construction of the turbine, and so makes it possible to construct the meter for measuring such gases as anhydrous ammonia.

It is found that by suitably proportioning the nozzles and the various other parts of the meter, it is possible to ensure that the speed of the turbine installed in this way is directly proportional to the total quantity of gas passing through the meter as a whole, so that in order to obtain a measurement of the actual volume of gas passing through the meter it is only necessary to record by counter the number of revolutions made by the turbine spindle.

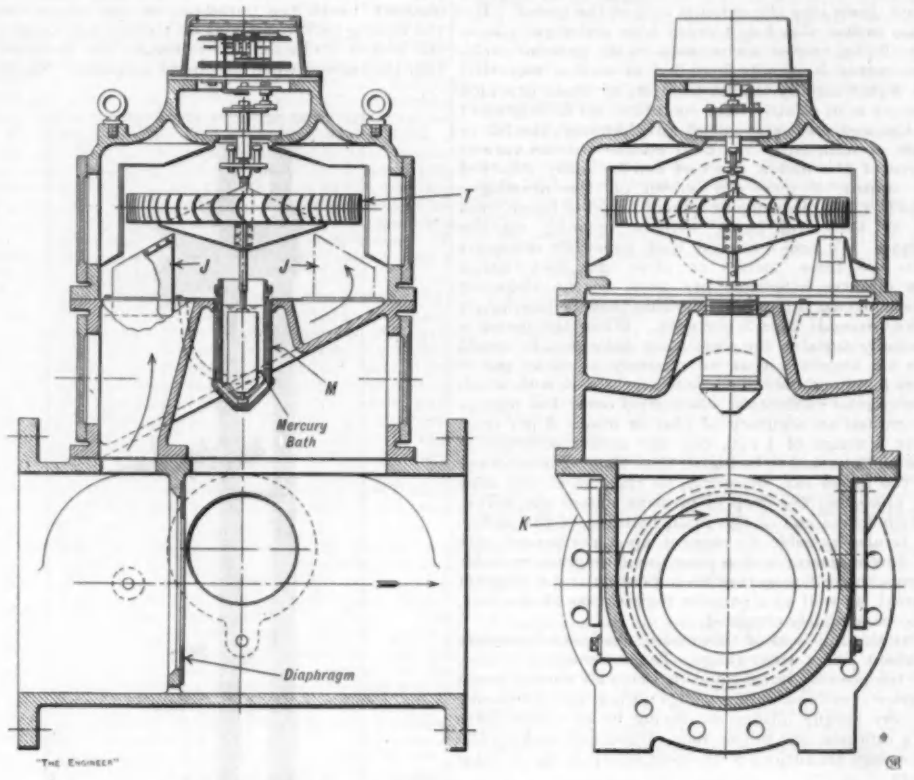


FIG. 12—SECTIONS OF METER FOR DIRTY GAS—KENT

In order to avoid any chance of derangement of the counter mechanism owing to dirt, deposit, or corrosion, the drive from the turbine shaft to the counter is made through a magnetic gland. That is to say, there is no mechanical connection between the two spindles, and one drives the other by the magnetic flux transmitted through a diaphragm. The counter train runs, adequately lubricated, in a completely sealed chamber, so that there can be no possible derangement of this part of the mechanism. As far as the running parts of the meter are concerned, there are therefore only the upper and lower turbine bearings which may give trouble. Both of these are covered by mercury so that they cannot possibly be deranged by dirt or deposit. There is also practically no load on either of them, as the major portion

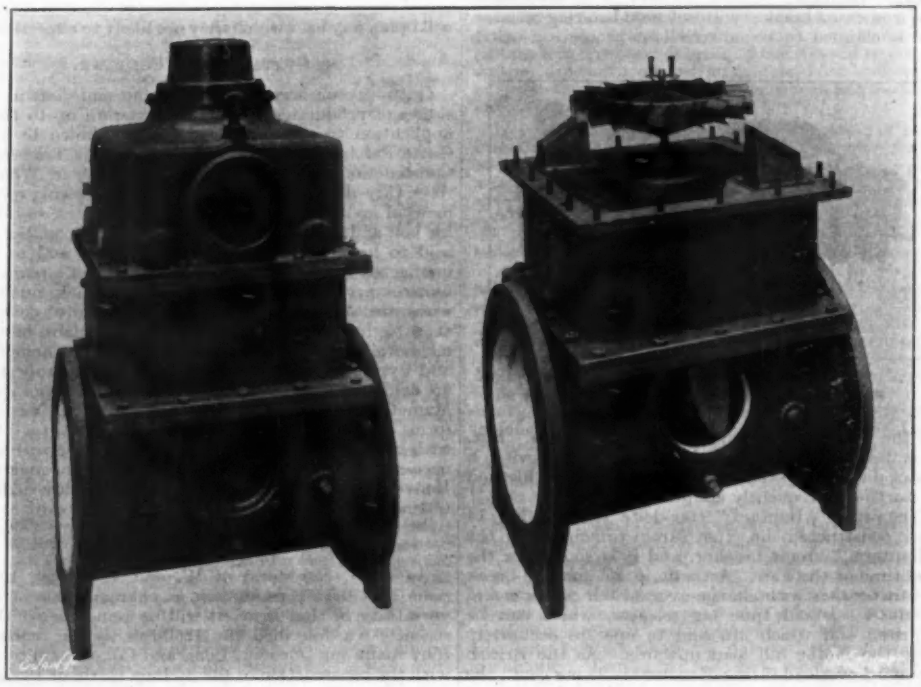


FIG. 13—METER FOR DIRTY GAS—KENT

of the weight of the turbine is taken by the float and the pressure due to the impact of the gas jets from the two nozzles is entirely balanced.

The makers say that sixteen years of experience with this meter have shown that it is entirely reliable for purposes of measuring clean gas, and the new development covers the modifications which are introduced to enable it to be used for the measurement of dirty gas. These consist of a special form of nozzle which has vertical or sloping surfaces from which tar drains readily. Also the casting on which the nozzles are carried has sloping surfaces which drain down into the exhaust side of the meter. The main orifice also has a drain hole underneath it so that liquid cannot accumulate on its upstream side. The meter is usually installed in such a way that all liquid rapidly drains from it, so that, provided the tar is in a fairly fluid condition, no derangement of the meter is experienced. If, however, the tar or dust is sufficiently thick to adhere to the various parts of the meter, the dirt can be easily removed by means of jets—not shown on the drawing—which enable cleansing or solvent liquid to be squirted on to the vital parts without opening up the meter. We are informed that gasworks engineers who use these meters on dirty gas find that a few minutes attention per week to the cleansing jets is all that is required to ensure that the inaccuracy never exceeds 2 or 3 per cent. While the meter is specially suitable for measuring dirty gas, it should not be forgotten that its accuracy on clean gas is very high, and only depends upon the care with which the original calibration was carried out. The makers guarantee an accuracy of plus or minus 2 per cent. over a range of 1 : 10, but the actual accuracy of the meter is said to be higher than this. The accuracy of the meter can, of course, be checked at any time by observing the drop of pressure across the orifice, which forms one of the main features of the meter. It is also possible to connect up a permanent rate of flow indicator and a permanent diagram recorder across the orifice so that an indication and a diagram record, as well as a counter registration of the flow, are continuously obtained.

At the full load of this meter, the loss of pressure is about 1in. of water gauge. The meter can, however, be temporarily overloaded to twice its normal rated capacity without damage. Its normal rated capacity is very simply altered by fitting in an orifice plate of a different size in the main circuit and making the necessary alterations to the gear wheels in the counter train.

GEORGE ELLISON, LTD.

A good display of switchgear is to be found on the stand of George Ellison, Ltd., of Perry Bar, Birmingham. Various types of circuit breakers are shown, ranging from a 15-ampère "Bantam" oil breaker up to 1500-ampère draw-out units with busbars complete for medium pressures. There are air break gate end breakers for mines and for other places where flame-proof switchgear is essential; high-tension cubicles; and truck type units. The latest "Bantam" circuit breaker is a substantial cast iron cased breaker with solenoid time lag releases, and is claimed to be an excellent protective switch

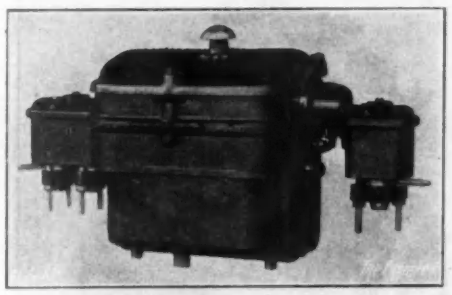


FIG. 14—"BANTAM" STARTER—ELLISON

for the direct starting of squirrel-cage motors. But, as is well known, it is not always possible to switch a motor direct on to the line, and the star-delta method of starting is frequently adopted.

The firm's "Bantam" star-delta starter—Fig. 14—is constructed on the same principles as the "Bantam" circuit breaker, and it is shown for the first time at the Fair. Actually it is a good oil-break circuit breaker with change-over switch contacts and overload solenoid time lag releases, which can be adjusted and which are said to operate accurately from the motor full load upwards. As the British standard overload rating of motors is 25 per cent., the importance of accurate tripping at relatively low load is evident if motors are to run at full duty and overheating is to be avoided. The time lag devices fitted to these starters restrain tripping at starting and prevent the sensitive solenoids operating on brief and harmless overloads, whilst providing the necessary low release setting for protection against sustained overloads.

A specimen of the new Ellison H.T. switch fuse, as shown in Fig. 15, is exhibited on full-size poles footed in the concrete floor and secured at the top to a roof truss. The great advantage of this switch fuse is that the switch can be operated from the ground without any other appliance and the fuses can be lowered to bring them within reach of a man standing on the ground. The patented operating gear comprises a winding drum fixed on the pole at a suitable level, and a pair of driving cables, which carry the fuses up or down and pass over grooved pulleys at the top. The fuses are mounted on a carrier which is securely clamped to the driving cables and balanced by counterweights. The operating gear may be padlocked with the fuses in any position. Rough operation of the gear cannot, it is claimed, break the porcelain, as the frame checks the closing movement and no stresses are thrown on the switch contacts. Horn breaks are provided to take the current when the circuit is opened. The fuses

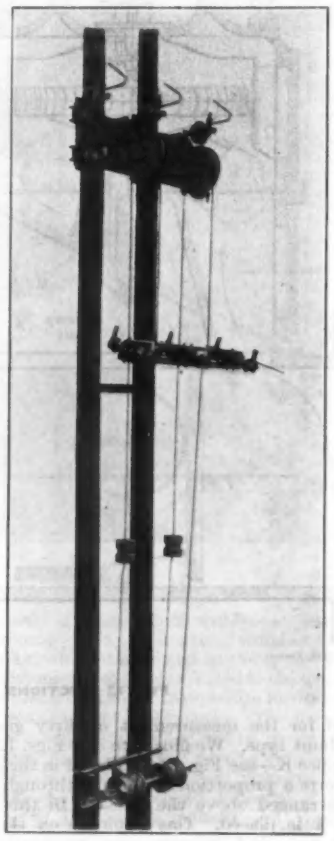


FIG. 15—H.T. SWITCH FUSE—ELLISON

are of the re-wireable type, and it is claimed that they will break any load which they are likely to experience.

THE GUTTA-PERCHA COMPANY.

Gutta-percha and allied insulating materials in all stages of production, from the raw state up to their application to submarine cables, are shown by the Gutta-Percha Company, a branch of the Telegraph Construction and Maintenance Company, of Wharf-road, City-road, N. 1. The company is showing specimens of its new "Telconite" insulated wires, suitable for bell and telephone circuits, &c. The insulation is said to have a high breakdown voltage, and to be unaffected by damp. When distinction of circuits is unnecessary, the wires are supplied in black, but the wires are also obtainable in a wide range of colours at a slightly higher cost. New applications of the magnetic products, Mumetal, Radiometal, Rhometal, and Pyromic are shown, and some of their properties are demonstrated. Well-known products incorporating Mumetal and associated alloys are exhibited. Various forms of the company's cables are shown, together with cable joints in various stages, together with the necessary tools and applicances for joint-making. Buoys, grapnels, sounding machines, buoy lights, testing sets sounding snappers, &c., are shown.

W. AND T. AVERY, LTD.

As usual, the stand of W. and T. Avery, Ltd., Soho Foundry, Birmingham, is characteristic of the versatility of that firm—it will be remembered that recently we described the 1250-ton testing machine they made for Dorman, Long and Co., in connection with the construction of the Sydney Harbour Bridge; while they have on show at the Fair balances for weighing such flimsy things as a little bit of silk thread—but perhaps the exhibit of most direct interest to engineers is that illustrated by Fig. 16. It is a direct-reading hardness testing machine.

This machine has been specially designed for rapidly determining the hardness of materials in terms of standard "D.R." penetration numerals. These numerals are based on the depth of impression produced by standard penetrators under the action of standard major loads. In order to eliminate errors due to imperfections of the surface of the specimens, the measured impressions are superimposed on those produced by a standard minor load.

The machine consists principally of a frame, an adjustable table, a loading device for the penetrators, a depth-measuring gauge, a weight-lifting and releasing mechanism, and a loading speed controller.

Two standard forms of penetrators are used, one being a steel ball of $\frac{1}{16}$in. diameter and the other a diamond cone of 120 deg. face angle, terminating in a spherical end. Both major and minor loads are imposed by means of proportional weights acting through a sensitive and accurate weighing lever, which is fitted with hardened steel knife edges. The standard minor load is 10 kilos., and this is applied automatically when the specimen is set up.

Two standard major loads are used:—100 kilos. for use with a $\frac{1}{16}$in. steel ball penetrator and 150 kilos. for use with the diamond cone penetrator. The proportional weights are suspended from the end lever, and are under the control of the operator. A rubber pad is interposed between the supporting platen, and the proportional weights to facilitate the gradual application of the ultimate load. Provision is made for reducing the major load to 60 kilos., and, if desired, special penetrators for making comparative tests can be adapted in the machine.

The depth-measuring gauge is a very accurate dial instrument, which gives direct readings in terms of the two standard penetration scales B and C. Scale B applies to the $\frac{1}{16}$in. diameter ball penetrator and 100 kilos. load, and the scale C to the diamond cone and 150 kilos. load. Graduations range from zero up to 100 for each scale, each division corresponding with 0·002 mm. movement of the penetrator.

The proportional weights are raised by means of a rack and pinion operated by means of a handle situated by the side of the machine. When the weights are in their raised position they are held by means of a spring plunger, which must be released in order to apply the load.

A plunger is attached to the weight-supporting platen, and is depressed when the load is being applied. This plunger works in a hydraulic cylinder, and the fluid which is displaced passes through a needle valve to the container. Exceedingly fine speed control is obtained by the regulation of this valve. An additional valve is provided to enable the fluid to flow back into the cylinder when the weights are raised.

In operation the specimen is placed on the rest and raised to contact with the penetrator, and further

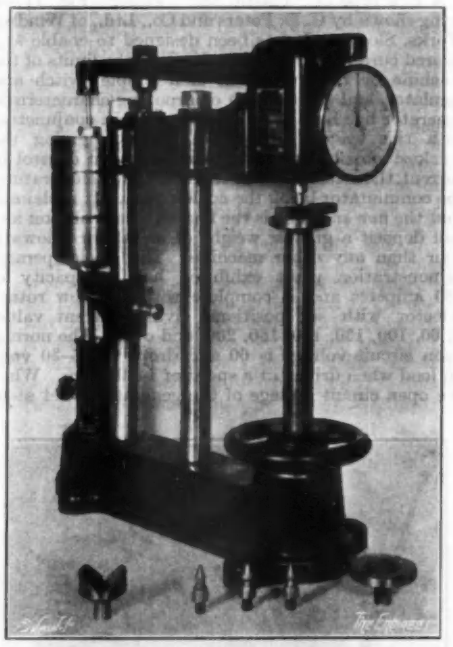


FIG. 16—HARDNESS TESTING MACHINE—AVERY

until the subsidiary hand of the gauge indicates "set." The minor load is thereby applied. If necessary, the dial is then turned so that the main hand of the gauge also indicates "set." The proportional weights are then applied, and, when the indicating hand ceases to move, they are raised and the hardness numeral read from the dial.

The distance in the machine exhibited from the penetrator to the standard is 5½in., and specimens up to 8in. thick can be accommodated. Usually the deformation caused by the test is so negligible that finished articles may be tested.

To be continued.)

THE number of coal cutters in use in the Indian coal mines during 1930 was 202, compared with 173 in the previous year. Of these, 191 were worked by electricity and 11 by compressed air. Up to the present, six-two mines have introduced coal-cutting machines on a large or small scale, and the total area undercut in 1930 was 11,170,000 square feet, as compared with 9,769,000 square feet in the previous year.

Railway and Road Matters.

AFTER testing cast iron road sections under heavy commercial traffic conditions at Stanton, West Ham, Islington, and Millwall, the Stanton Ironworks Company, Ltd., has decided to put them on the market. They cost about 20 per cent. less than granite setts.

ANSWERING a question addressed to him on February 17th, the Minister of Transport said that the late Government decided not to renew the offer of a grant towards the rebuilding of Charing Cross Bridge and the present Government was in accord with that decision.

HITHERTO the divisional officers at Crewe and Derby respectively who have been responsible to Mr. J. E. Anderson, the superintendent of motive power, London, Midland and Scottish Railway, have ranked as assistants. In future Mr. W. Land will be known as the divisional superintendent of motive power (Western Division), Crewe, and Lieut.-Colonel H. Rudyard as divisional superintendent of motive power (Midland Division), Derby.

IN order to cope with the increased demand from abroad for coal from the Kent coalfields, the Southern Railway Company is installing on the eastern arm at Dover Harbour an extensive coal-handling plant for loading coal into ships. The plant, which will cost approximately £22,000, will be electrically operated. Because of the exposed position and the very high winds which prevail at Dover, the machinery will be housed as far as practicable in an enclosed gallery constructed of reinforced concrete.

A PRELIMINARY statement issued by the Canadian National Railways shows that the operating revenue for the year 1931 was approximately 177,223,700 dollars, as compared with 221,770,445 dollars for 1930. The operating expenses were 169,685,000 dollars, as compared with 195,259,507 dollars, a decrease of 25,571,507 dollars. Net operating revenues will be close to 7,585,700 dollars, as against 26,510,938 dollars, a decrease of no less than 18,925,238 dollars. These figures cover all lines comprised in the National system, except those east of Levis and Diamond Junction, which are operating under the Marine Freight Rates Act. The traffic earnings in 1931 were the lowest experienced in any year since the present system came into existence.

THE report for 1930–31 of the South African Government Railways states that work on the electrification of the 26 miles between Masons Mill and Cato Ridge was begun in April last. The cost is estimated at £176,000, but £100,000 of this will be borne by the Electricity Supply Commission—we presume because the sub-stations, transmission lines, &c., will also be used for public purposes. The report observes that the whole of the 1600 steel masts required for transmission along the railway will be manufactured in the railway workshops from second-hand rails and will cost less than a sixth of the price which would have had to be paid for imported new masts. The whole of the work on the railway is being done by railway forces under the department's engineers at approximately 50 per cent. lower cost than the estimate furnished some years ago by the consulting engineers.

WITH the declaration, on February 19th, of the London and North-Eastern final dividend for last year the results of the working of the four grouped companies during 1931 are now known. The London, Midland and Scottish gross receipts amounted to £70,754,231 and the expenditure was £58,998,952. The corresponding figures for 1930 were £76,445,101 and £64,468,392. The dividend on the ordinary stock for 1931 was ¼ per cent., as against 2 per cent. in 1930. The Great Western gross receipts were £31,139,630, as compared with £34,346,867 in 1930, and the expenditure was £26,052,984, as against £28,266,477. The result was a drop in the dividend for the year on the ordinary stock from 5½ to 3 per cent. The gross receipts of the Southern fell from £25,890,141 in 1930 to £24,373,592 in 1931, but the expenditure was also reduced from £20,701,720 to £19,761,665. As a consequence the 5 per cent. dividend on the preferred ordinary stock of 1930 was reduced to 4 per cent., and nothing was paid on the deferred ordinary, in contrast to 1¼ per cent. in 1930. The London and North-Eastern gross receipts fell from £59,825,409 to £53,828,366, and the expenditure was reduced from £49,206,100 to £44,989,556. In 1930 there was no dividend on the deferred ordinary stock, and it is the same for 1931; a year ago, by taking £222,568 from reserve, a nominal dividend of ¼ per cent. was paid on the preferred ordinary, but this year those holders get nothing. Moreover, instead of the second preference shareholders getting 4 per cent., as in 1930, they get only 1 per cent.

IN *The Times* of February 9th appeared an article by that journal's commercial motor correspondent which would, no doubt, be read with interest by the general public, and afford much satisfaction to the commercial motor industry. It described how freshly-cut flowers are conveyed, on arrival of the steamer from the Scilly Islands, from Penzance to London, a distance of 305 miles, in 14½ hours—21 m.p.h. This led to a question in Parliament on February 11th, wherein the Minister of Transport was asked whether, in view of the impossibility of maintaining the service without frequent breaches of the speed limit, he proposed to take any action. To this inquiry, Mr. Pybus replied that that was a matter for the police whose attention was being drawn to it. There is, however, we would point out, another side to this question. That was, perhaps, best revealed in a leading article in *The Times* of Saturday, the 13th, which said: "Mr. Pybus has correctly referred the question of lawful speed to the police; but the question that lies behind it is whether it is in the national interest that the service by road should be employed at all. The competition between roads and railways, in spite of many recent attempts to diminish it, is still one of the most wasteful features in our economic life. . . . It is impossible for anyone to reflect with satisfaction on the spectacle of our great established railway systems crying out for work to make them remunerative, while these 120 horse-power lorries race down the roads from end to end of England, impeding the light traffic for which the roads are better fitted and piling heavy charges for upkeep year by year on an impoverished public."

Notes and Memoranda.

AN arrangement, we are given to understand, has been made between the British railway companies and Imperial Airways for the rail-and-air transport of parcels and other freight. It applies to consignment of traffic—with certain limitations of weight and size—carried at through rates from a large number of British railway stations to places abroad served by Imperial Airways, and *vice versa*. In the case of export traffic the packages will be forwarded by the first available passenger train to the London terminus of the railway receiving them. From there they will be collected by Imperial Airways, conveyed to Croydon, and thence dispatched by air to their destination.

AN innovation in aviation accomplishments was demonstrated recently by Captain-Commandant of Rodgers Field, when he flew over Pittsburg, Pa., in a Curtis bombing plane with a tremendously powerful searchlight mounted on his ship and set off a flare located on the top of one of Pittsburg's hotels. This new searchlight, a very compact unit weighing a little more than 50 lb., and about 18in. in diameter, yet which may throw a beam visible more than 50 miles, was developed by the Westinghouse Electric Company. This small unit employ a 250-watt lamp, and may be operated from an ordinary storage battery. It concentrates a narrow beam of light so powerful that a newspaper may be read at a distance of 5 miles.

THE Hoover Dam, which is being built in America, may be completed one year earlier than expected. According to latest reports, a new record for the amount of excavation in a single day was established on January 20th last. On that day 256 linear feet of progress was made in the enlarged tunnels. More than 16,000 cubic yards of rock were removed in a 24-hour period; while during the week nearly 1700 linear feet of 41ft. by 56ft. heading were excavated. Only 570ft. remained on January 23rd between the headings in tunnel No. 2 and 410ft. in tunnel No. 3. Progress is also being made on the designs for the bulkhead gates at the inlets of the outer diversion tunnels and for the Stoney gates at the outlet ends of the inner diversion tunnels.

FOLLOWING the success of the Trieste station, the recent opening of the Florence broadcasting station marks a further important advance in the reorgansation of the Italian broadcasting system undertaken by the E.I.A.R.—the Italian Broadcasting Company. The transmitter for Florence, like those for Trieste and the next projected station at Bari, was manufactured by the Marconi Company at Chelmsford. The energy of the transmitter is 20 kilowatts, reckoned in accordance with the new method of rating decided upon at last year's Copenhagen meeting of the International Technical Consultative Committee for Radio-Electric Communications. Modulation can be effected up to 100 per cent., and while the Florence station is scheduled to operate on the wavelength of 500·8 m. (599 kilocycles) the wavelength of the transmitter can be varied between 250 m. and 550 m. if required.

THE United States Department of Commerce has lately issued a report, based on the Industrial Census taken in 1930, on the use of electric motors on farms in the United States. The figures cover 3,650,003 farms throughout the country, and show that of these only 4·1 per cent., or about 149,650, were equipped with electric motors, while 15 per cent. of the farms were provided with stationary gas and oil engines. On the other hand, the 4·1 per cent. users of electric motors had a total of 1,381,191 machines installed, as against only 1,131,108 gas and oil engines for the 15 per cent. users of this class of power unit for farming purposes. The average figures are in a way deceptive, for the return shows that while the farms in the State of Mississippi have only 0·2 per cent. of the total electric motors, California has 32·2 per cent. Similar variation is reported in connection with stationary engines, the range being from 0·6 per cent. in Mississippi to 50·4 per cent. in Minnesota.

REVELATIONS of how grass and soil near coke ovens were found to be impregnated with deadly poisons were made by Mr. H. C. L. Bloxham in a recent address to the Society of Chemical Industry at Newcastle. The first clues to the presence of such poisons in the ground were reports from farmers whose land adjoined coke oven works, said Mr. Bloxham. One farmer reported to the Society of Chemical Industry that since 1929 he had lost twenty-five sheep and one cow. An analysis of the organs of the animals disclosed traces of lead, copper, and manganese. A tray and a bottle were buried in the field where the beasts had been grazing, so that the atmospheric dust as it was washed off the tray by the rain would collect in the bottle. In the atmospheric dust and in the rain-water lead, copper, and manganese compounds were found. There seemed to be no doubt that the emanations from the coke oven works contained both lead and copper compounds. Lead was found in the soil 2ft. below the surface of the field.

POLES supported in the ground are usually creosoted to prevent rotting, but difficulty is often experienced in afterwards painting the exposed parts of such poles, either for decorative or visibility purposes. Highway engineers now usually insist on the poles used for fencing along roads being made clearly distinguishable at night, and for this purpose aluminium paint, with its high reflectivity, forms an ideal medium; not only can it be easily applied, but it retains its brilliance for long periods. In an investigation into the usefulness of different classes of paint for painting creosoted wood, the paints experimented with were white cellulose paint, green lead paint, green zinc paint, and aluminium paint. One coat of each was applied to creosoted poles set up in the ground and allowed to dry out for three weeks before painting. After exposure to the weather for two years it was found that whereas the cellulose, lead, and zinc coatings had failed as regards retention of their original colours, and had in the main assumed the colour of the creosote, the aluminium paint had retained its colour. The vehicle was a hard, dry, long-oil varnish type, containing 50 per cent. by weight of non-volatile oils and gums. The major portion of the vehicle consisted of heat-treated China wood oil, and the remainder of heat-treated linseed oil. Aluminium powder was added in the proportion of 2½ lb. per gallon.

Miscellanea.

A GROUP carrying out prospecting work in the Khakassk-Minussinsk region of Siberia has discovered fresh copper deposits. The largest of these were at Bazyrsk, where, according to the preliminary data, the deposits are not less than 500,000 tons. These are only the initial results of the investigation, so far only six copper deposits of a total of over 300 in the district having been prospected.

NO further progress, we learn, has been made with the salvage of the submarine "M 2," which dived in the West Bay, off Portland, on January 26th, with the loss of sixty lives. Mr. E. F. Cox, of the salvage firm of Cox and Danks, Ltd., recently inspected the buoys marking the spot. The date now mentioned for the probable resumption of the salvage operations is March 6th, if the weather conditions are favourable.

DRIVING the "Blue Bird," the car in which he made a motor speed record last year of 245·736 miles an hour, Sir Malcolm Campbell made on Wednesday last, February 24th, a new record of 253·968 miles an hour. The official times for his two journeys over the measured mile were:—First run, southwards, 267·459 m.p.h., time 13·46 sec.; second run, northwards, 241·773 m.p.h., time 14·89 sec.; average speed, 253·968 m.p.h.; average time, 14·175 sec.

TWO Germans named Schuetze and Sucksdorf, who went up from Bittenfeld in the open gondola of a balloon with instruments for measuring the influence of the light rays in the heights, spent six hours at a height of over 27,000ft., and made their observations in spite of a temperature of 40 deg. below zero. The balloon sailed over the Hartz Mountains, and came to earth in Westphalia. "We are quite satisfied with the results of our trip," the balloonists state.

ACCORDING to preliminary estimates of gold production for 1931, the Yukon Territory and the gold-producing provinces of Western Canada accounted for some 291,000 oz., or nearly 11 per cent. of the total production of the country. Manitoba's output advanced sharply from 23,189 oz. in 1930 to 100,510 oz. in 1931. The output from British Columbia decreased from 164,331 oz. to 153,934 oz., and that of the Yukon was slightly in excess of the previous year.

A CONSIGNMENT of British light aeroplanes bought by Brazil was shipped to Rio de Janeiro in the Blue Star liner "Andalucia Star," last Saturday. The machines are 120 H.P. Gipsy-engined Moths, and they will be used for training purposes in the Brazilian Army and Navy. Captain Broad and Mr. W. T. W. Ballantyne are accompanying the aeroplanes, which are the first British aircraft to be used by the Brazilian forces, and will demonstrate them to the authorities.

A VAST engineering project for the development of 400,000 H.P. of electricity, and the opening up of the whole northern area of Manitoba to transportation, has been tentatively approved by the Provincial Government, provided the difficulties of the way can be overcome. It is proposed to divert the Saskatchewan River, which drains a territory 400 miles wide, into Lakes Winnipegosis and Manitoba, and thence by a new channel into Lake Winnipeg. Lake Winnipeg is 100ft. lower than Lake Manitoba, and it is proposed to construct a channel from Sturgeon Bay to carry the water to the edge of the former lake, where a head of 80ft. would be available. It is reported that the scheme gives every promise of being practicable from an engineering standpoint, but the enormous expenditure involved will necessarily delay operations, until the financial situation improves. The cost is estimated at anywhere between 40,000,000 and 60,000,000 dollars, depending on the amount of hard rock to be moved in the 24 miles of new river channel, and the building of the power plant.

IN opening the new £60,000 physics building of Leeds University, Sir William Bragg, who was formerly Cavendish Professor at Leeds, said that they parted with the old place with a certain regret. Researches had been made there which had opened the way to discovery all the world over. Stroud's wonderful skill produced the rangefinder, the first X-ray spectra were measured there, and the first observations were made from which the structure of crystals was determined. He asked if it were not possible to see more of John Citizen himself in the laboratory. Of late years the science museum had advanced in popularity and usefulness by leaps and bounds, and the well-organised science museum in South Kensington was visited by far more than 1,000,000 persons a year. A huge museum was in course of erection in Philadelphia, while the great museum in Munich was famous. Such exhibitions were of proved value. If any effort were made to follow these examples set elsewhere then the Leeds University laboratories would naturally be looked to for help. Sir William Bragg's address was relayed from the new laboratory to a large audience assembled in the great hall of the University.

FIGURES showing the effect on the shipbuilding industry of the cessation of work on the Cunard liner were given at a recent meeting at York of the Engineering and Shipbuilding Trades Federation. Mr. W. Sherwood presided. Directly and indirectly, it was stated, the stoppage had affected 10,500 members; the weekly amount of unemployment insurance paid out amounted to £14,000, and that more than £100,000 had been paid to disengaged workers in this way. During the last three months of work in John Brown and Co.'s yard, it provided more than half the wages paid in the Clyde area. With regard to the prospects of employment in the industry generally, it was stated that in December, 1931, there was an average of 60·2 per cent. unemployed on a greatly reduced number of persons engaged in the industry. It ranged as high as 72·9 per cent. against a percentage of all other trades in September of 23·2 per cent. Less than 250,000 tons of new shipping had been ordered, or one-seventh of the orders placed in 1929. The meeting adopted a resolution welcoming the reopening of negotiations between the Government and the Cunard Company, and trusting that the resumption of work would be speedy in view of the acute destitution and poverty existing in the shipbuilding industry.

STANLEY ABATTOIR AND MEAT MARKET, LIVERPOOL

(*For description see page 228*)

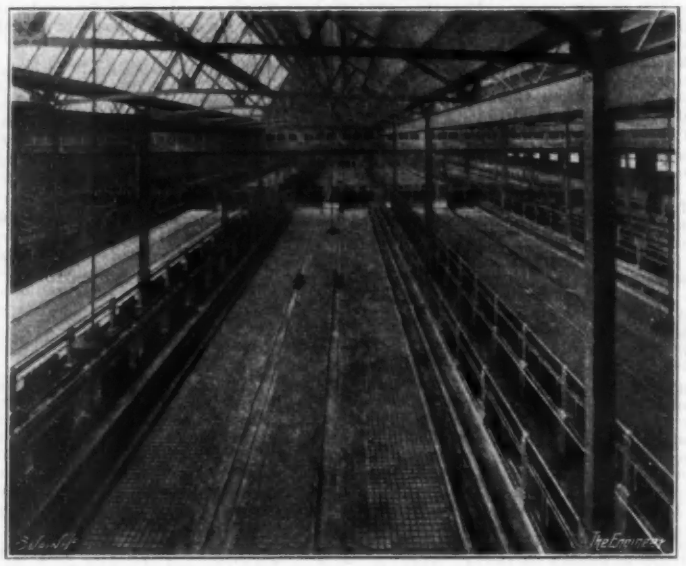


FIG. 10—CATTLE MARKET

FIG. 11—CATTLE MARKET, ENTRANCE AND WEIGHING MACHINE

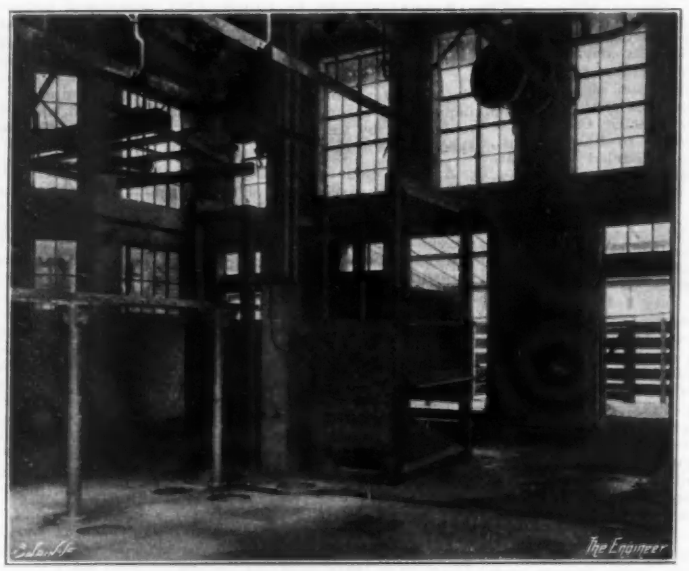


FIG. 12—PART OF MAIN SLAUGHTER HALL

FIG. 13—PIG SLAUGHTER HALL

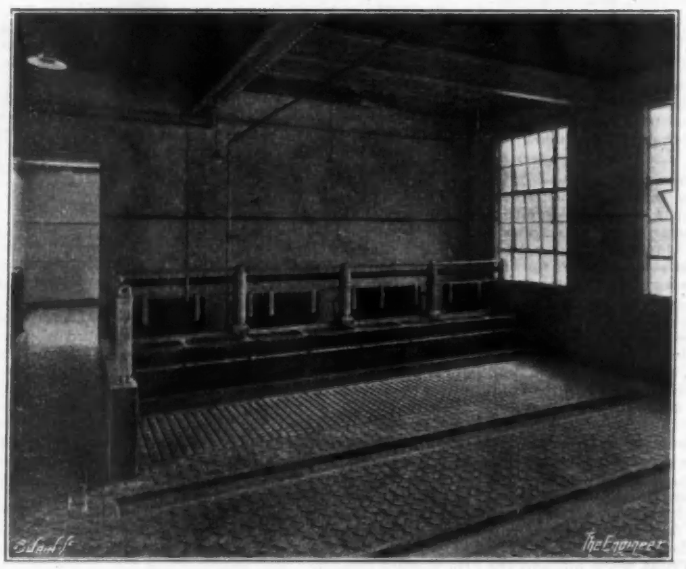


FIG. 14—SUSPECT ANIMALS LAIRAGE ACCOMMODATION

FIG. 15—MEAT MARKET—EAST SECTION

The Engineer

FEBRUARY 26, 1932.

VOL. CLIII. No. 3972

Contents.

THE ENGINEER, February 26th, 1932. PAGE

A SEVEN-DAY JOURNAL .. 227
NEW ABATTOIR AT LIVERPOOL. (Illus.) .. 228
INSTITUTION OF MECHANICAL ENGINEERS .. 231
LETTERS TO THE EDITOR—
As I See It—Profit-sharing—British Express Locomotive Design—The Sandberg Process .. 232
STEEL TRADE OF THE WORLD .. 232
ENGINEERING INSTITUTE OF CANADA .. 233
THE VENTILATION AND COOLING OF TURBO-ALTERNATORS .. 233
ATMOSPHERIC CONDITIONS IN THE BLACKWALL AND ROTHERHITHE TUNNELS .. 233
THE BRITISH INDUSTRIES FAIR AT BIRMINGHAM. No. II. (Illus.) 234
RAILWAY AND ROAD MATTERS .. 237
NOTES AND MEMORANDA .. 237
MISCELLANEA .. 237
LEADING ARTICLES—
The Phenomena of Lubrication .. 239
Foreign Manufacturing in Great Britain .. 239
Technical Education in England, Scotland, and Ireland .. 240
Rail and Road .. 240
LITERATURE .. 240
AN ACCELERATED TEST FOR THE DETERMINATION OF THE LIMITING CREEP STRESS OF METALS. (Illus.) .. 241
SIXTY YEARS AGO .. 242
THE INSTITUTION OF CHEMICAL ENGINEERS .. 242
AN AUTOMATIC VARIABLE TRANSMISSION GEAR. (Illus.) .. 243
THE SALERNI SYSTEM OF LOW-TEMPERATURE CARBONISATION .. 243
CEMENTATION IN THE SEVERN TUNNEL .. 244
36IN. ISMAILIA TIDAL FLAP VALVE. (Illus.) .. 244
THE LONDON IRON AND STEEL EXCHANGE .. 244
CANADIAN ENGINEERING NEWS .. 245
PROVINCIAL LETTERS—
The Midlands and Staffordshire—Lancashire .. 245
Sheffield—North of England .. 246
Scotland—Wales and Adjoining Counties .. 247
PERSONAL AND BUSINESS ANNOUNCEMENTS .. 247
CONTRACTS—CATALOGUES .. 247
CURRENT PRICES FOR METALS AND FUELS .. 248
FRENCH ENGINEERING NOTES .. 249
BRITISH PATENT SPECIFICATIONS. (Illus.) .. 249
FORTHCOMING ENGAGEMENTS .. 250

EIGHT-PAGE SUPPLEMENT—THE BRITISH INDUSTRIES FAIR AT BIRMINGHAM; SIXTEEN-PAGE SUPPLEMENT—"THE METALLURGIST."

The Metallurgist.

THE FEBRUARY NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

NOTICES TO READERS.

**** If any Subscriber abroad should receive* THE ENGINEER *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

**** For Subscription rates see page 2 of Advertisements.*

**** All letters intended for insertion in* THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

**** No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.*

DEATH.

ON February 23rd, at Sandiacre, near Nottingham, JOHN HENRY HAMILTON, B.Sc., late Managing Director of the Premier Gas Engine Company, Ltd.

THE PHENOMENA OF LUBRICATION.

THE primitive belief that a lubricant acts by interposing something in the nature of a molecular ball-bearing between loaded surfaces in relative movement cannot be sustained in the light of modern research. There is now abundant evidence that lubrication is a phenomenon not only of tremendous practical importance, but of intense scientific interest, and that fundamentally it presents a highly complex subject of study. The discoveries which have been made in connection with what is called boundary lubrication have shown us that hydrodynamical theories are not sufficient to account for all the observed facts, and that in certain circumstances lubrication is probably as much a chemical as a mechanical phenomenon. Under the conditions of boundary lubrication there is, in the opinion of many investigators, a chemical union between the metal surfaces and the lubricant, with the result that within the space of a few molecular diameters we have, in succession, molecules of metal, metal oleate, oil, metal oleate, and metal. In some cases the intermediate layer of oil molecules may be absent, with the result that the contact existing is actually one between metal oleate and metal oleate. Other investigations have produced evidence which strongly suggests that electrical phenomena may enter into lubrication to a prime extent. Many experiments have been made on the effect of adding various materials to an oil or grease lubricant. Very striking results have been achieved, as recounted in our issue of Sept. 27th, 1929, when the added material is zinc oxide. It has been found that loaded ferrous surfaces, when lubricated with an oil or grease containing a considerable percentage of zinc oxide, soon become coated with a highly polished film of metallic zinc of submicroscopical thickness. If the part after being coated is taken out of service, the film, as our own observation proves, will persist for an indefinitely long period with scarcely diminished brightness. Under running conditions, however, it seems certain that the film is maintained at a constant submicroscopical thickness by a balance between the rate at which the zinc is deposited and the rate at which it is oxidised and returned to the body of the lubricant. Those responsible for this investigation are satisfied that the metallic zinc is deposited as a result of an electrolytic action following the generation or release of minute electrical currents on the surfaces in contact. It is certainly difficult to advance any strong reason for doubting that explanation.

Some additional facts illustrating the fundamentally complex nature of the phenomenon of lubrication are supplied by a report from Mr. C. G. Williams, published in the February issue of *Mechanical Engineering*, the journal of the American Society of Mechanical Engineers. Lubricants compounded of oil and lead oleate—that is to say, soap in which the soda or potash is replaced by lead—have, for some time, been obtainable commercially. The precise conditions under which Mr. Williams sought to employ such a lubricant are not very clearly stated, but we gather that he was dealing with heavily loaded bearings, running at high speeds and subjected to a certain amount of vibration. The bearings were of various kinds—ball, roller, bronze-lined, and babbitted. Several phenomena were observed. The mildest was an intermittent, will-o'-the-wisp, glow, which played about the bearing and which was visible only in the dark. At times spurts of flame up to 6in. in length would appear emerging from the bearing, either by themselves or accompanied by a glow. On occasion the flames would crackle like an electric spark. Signs were observed that a light-bluish gas having a smell resembling that of ammonia was being formed in the bearing. In several instances the phenomena culminated in a violent explosion, accompanied by spurts of flame up to 2ft. in length. The explosions were sometimes of a destructive character and blew the caps off the bearings or fractured them. In one recorded case the explosion was sufficiently violent to bend and stretch four 1½in. studs by which the cap of the bearing was held in place. In all cases these phenomena were not observed until some time after the bearing began work. After an explosion there was a noteworthy absence of an oily feeling on the parts of the bearings. Instead of any trace of oil, the parts were frequently found to be covered with a thin layer of a pinkish brown, or greyish pink substance. Discussing the cause of these startling occurrences, Mr. Williams suggests that in the first instance they may be produced by the draining away of the oil particles of the lubricant, possibly by capillary action, accompanied by the retention between the surfaces of nothing but particles or molecules of lead oleate. Under the resultant frictional heat and the high pressure, he suggests that a chemical transformation occurs in the lead oleate. Whether the product of that transformation is an explosive gas or some other explosive substance, he is not prepared to say, but he calls attention to the fact that lead forms several compounds which possess the properties of a high explosive. Among those compounds are lead azide, lead trinitride, lead imide (Pb N H), and lead hyponitrite. All these, and, so far as we know, all the explosive or detonating lead compounds involve the union of lead with nitrogen in some form or other. Mr. Williams is apparently at some loss to explain from what source the lead picked up the nitrogen or ammonia, but we are not inclined to reject his theory on that account. In the production of the lead oleate lubricant, particularly if castor oil were the basis of the oleate, there would be plenty of opportunity, under commercial conditions, for the introduction of the quite small quantities of nitrogen or nitrogenous compounds required to satisfy the explanation.

From inquiries which we have made we learn that phenomena of the kind reported by Mr. Williams are totally unknown with the lubricants containing zinc oxide. That fact is possibly of some importance in assessing the probability of Mr. Williams' theory being correct, for, granted the presence of nitrogen, explosive compounds of zinc might be formed in bearings almost as readily as explosive compounds of lead. For example, zinc hydroxylamine and zinc azide are explosive, and so, too, is the ammoniated perchlorate, while zinc permanganate is liable to explode by reason of the readiness with which it is reduced and evolves oxygen. The complete absence of any explosive tendency with zinc-containing lubricants suggests some caution in accepting Mr. Williams' theory concerning the formation of explosive and detonating compounds of lead in the bearings upon the behaviour of which he has reported. Nevertheless, that fact alone does not justify our ruling out Mr. Williams' theory as too highly speculative. The phenomenon of lubrication is so very complex and involved in many of its aspects that it is quite conceivable that while explosive lead compounds might be formed with a lead-containing lubricant, the formation of equally possible explosive zinc compounds might be inhibited with a zinc-containing lubricant. If Mr. Williams' theory is correct, it will provide the starting point of another great step in our understanding of the phenomenon of lubrication.

Foreign Manufacturing in Great Britain.

THE urgent need for correcting our balance of trade tends to make us consider the effects both of the new protective tariffs and of the abandonment of the gold standard almost exclusively from this point of view. Both these changes will, it is hoped, benefit the home manufacturer by providing him with a more assured home market and, temporarily at any rate, by increasing his competitive power abroad. While, however, the time has hardly been long enough for any great result to be noticeable in either of these directions, a secondary effect has already become evident. A number of foreign firms, finding the richest market in the world partially closed to their products, and foreseeing perhaps an effective system of trade preference between the countries of the British Empire, have decided to take advantage of the new conditions by manufacturing in this country. By so doing the hindrances to their trade will be turned into benefits, for tariffs, preferences, and depreciated currency have a totally different aspect according as they are regarded from the inside or the outside of a protecting wall. The tendency for foreign manufacturers to establish works here has, moreover, been stimulated by the active efforts of our railway companies and certain municipal authorities to attract new industries to the areas in which they are interested.

Whilst the reports in the Press that immigrant firms are likely to be numbered by hundreds and to represent almost every kind of industry are exaggerated, we have trustworthy evidence that a not inconsiderable number of "foreign" factories are likely to be set up. In general the immigration is regarded with complacency and even with satisfaction. It is taken to be evidence of the brighter industrial outlook for the country, and justification for the changes in fiscal policy. The construction and operation of new factories must, it is argued, create sadly needed employment for our workmen, while the articles produced must improve our trade balance either by displacing an equivalent volume of imports by home-made goods or by increasing the volume of our exports. Attractive as such results would be, the argument is worth a little examination. Its strength, of course, depends upon the assumption that a new market can be found, either at home or abroad, for the output of the new factories. For if the demand does not expand, the products of the new factories can only be sold by displacing those of existing works, the process causing intense competition and inevitable losses. It is particularly noteworthy that this influx of new factories should coincide with the policy of many British industries to reduce their own manufacturing facilities. The buying up and dismantling of shipyards, cotton mills, &c., and the rationalisation of other industries with a view to the suppression of redundant factories have for some time been accepted as the only cure for the depression of the particular trades concerned; even where such action has not taken place, it would be generally welcomed by those engaged in the struggle for trade. We are therefore faced with the paradox of a country attributing the depressed state of its industries largely to the presence of too many competing factories, while at the same time it looks benignly on organised efforts to induce foreign industrialists to come and start more. The matter must, however, not be looked at entirely from the home point of view. Every new factory in England constitutes an increase in the world number of factories, and unless world employment in any industry can be increased, British employment in that industry can only be expanded by a corre-

sponding reduction of employment elsewhere. Such a result, even if it came about, cannot be regarded as wholly satisfactory, though possibly it might relieve us of some of our present troubles at the expense of our neighbours. At any rate, it is certainly not the motive of the foreign manufacturers who are coming to our shores. Their concern is neither to give employment to British workmen nor to assist in the rectification of our trade balance. As business men, they seek to establish themselves here because they think they see a profitable field for their enterprise. They are willing to bear all the risks and expense in starting to manufacture goods in a country whose language, customs, laws, currency, and weights and measures are strange to them, and where they are bound to face intense competition from native firms without such handicaps. They alone know the particular reasons on which they count for success. They will have to pay the same wages and taxation as our home firms, and will have to work under exactly the same conditions. None of them, so far as we know, are proposing to manufacture anything which is not already produced or could be produced at very short notice by our existing firms. Moreover, technical secrets, even when they can be said to exist, are so short-lived that their possession could rarely justify the establishment of factories abroad merely to exploit them.

The only reason, therefore, that one can see for the influx of foreign manufacturing firms which is certainly taking place is the comforting one that they believe—and believe strongly enough to back their opinions—that there will be work for all at no distant date. But there still remains the question whether the expansion of trade which is counted on could not be met by the development of our indigenous firms as well, at least, as by branches of foreign firms established here for the purpose. If the new-comers could bring with them new arts or crafts there would be reasons for welcoming them with open arms. England has owed much in the past to the importation of workers skilled in processes first developed on the Continent. But the same conditions no longer exist. In modern industry the craftsman has almost entirely given way to the machine-minder. Equally good machinery can be obtained by every country, and the knowledge of manufacturing processes is universally disseminated by books and technical journals. The assets which give one firm a pre-eminence over others will almost always be found to consist in the energy and progressive nature of its management and the competence of its selling methods. These are the imponderables which nowadays, more than ever, are necessary to success. If British firms are to get the anticipated benefit from the securer market at home and the more favourable opportunities in the Dominions, they must leave no room for any complaint as to their vision or enterprise. Sheltered by a tariff, it is to be hoped that they will be able to find sufficient funds for the ceaseless experiment and research needed for progress. Unless a manufacturer is prosperous he cannot afford either to develop new inventions or even to scrap machinery that should be considered obsolete. The consumer therefore suffers from the want of progress, and ultimately the manufacturer may be forced out of business or linger miserably, dependent on the inventions developed by some foreign firm under the shelter of a tariff. The tendency which we have so often deplored of British firms purchasing licences from abroad to make something which ought to have been developed by themselves is no doubt due in part to lack of money for the development of indigenous inventions. If this tendency can be reversed by a reasonable measure of prosperity, the change of policy which has now taken place will be welcomed even by confirmed free-traders. That foreign firms should establish themselves here to take advantage of that change is, on the whole, of good augury, for unless they had satisfied themselves that there would be in future a profitable field for enterprise in this country they would hardly have decided to incur the disabilities of language and custom which are inevitable for them. There would seem to be a moral to draw from the immigration.

Technical Education in England, Scotland and Ireland.

THE scheme under which the Institution of Mechanical Engineers, in conjunction with Government education departments, awards National Certificates and Diplomas in Mechanical Engineering has now been sufficiently long in existence to enable us to draw certain deductions without much fear that our conclusions will be distorted by chance results. On analysis the figures presented each year in the Institution's annual report reveal a very remarkable situation, which seems to reflect in more ways than one upon the respective states of technical education in England, Scotland, and Northern Ireland. Taking the aggregates over the past seven years—six years in the case of Northern Ireland—we find that the total number of candidates who have entered for the Institution's examinations amounts to 13,018 in the case of England, 622 in the case of Scotland, and 163 in the case of Northern Ireland. Of these candidates, 55, 77, and 42 per cent. respectively were successful in obtaining certificates or diplomas. These figures represent, not only the average results over a number of years, but the relative order of the three countries in any one year. Never once has Scotland failed to show a higher percentage of successes than England. Only once—with two candidates of whom both were successful—has Ireland been elsewhere than at the foot. Year by year the English percentage of successes has been remarkably constant, never falling below 53 and never rising above 57. Scotland's worst year —1926—showed 59 per cent. of successes, but with that exception her figure has lain between 70 and 85 per cent. Except in 1926, when she registered her 100 per cent. of successes, Ireland's figure has been between 34 and 52. The awards made to the successful candidates are of four kinds, namely, in ascending order of merit, ordinary certificates, higher certificates, ordinary diplomas, and higher diplomas. Each year English candidates have succeeded in all four categories. No Irish candidate has as yet gained either an ordinary or a higher diploma. No ordinary diploma has gone to Scotland; all the diplomas awarded to Scottish candidates have been of the higher category. With less than one-twentieth the number of candidates, Scotland, during the seven years, has received 108 higher diplomas to England's 189. Put otherwise, of the Scottish candidates, 22·3 per cent. succeeded in gaining higher diplomas, as compared with 1·4 per cent. of the English candidates. Even if we include the ordinary diplomas gained by the English candidates, Scotland's relative position is not affected. The combined successes in the two higher categories remain at 22·3 per cent. for Scotland. For England they amount to 5·9 per cent. Here again these aggregate figures are a faithful representation of the individual figures for any one of the seven years. One other statistical fact may be worth noting. The average number of candidates entered for the examinations each year is 18 per institution, school, or college in England, 24 in Scotland, and 5 in Ireland. We present these figures for the consideration of those of our readers who are interested in the promotion of technical education. We will make no suggestions as to the deductions which may be drawn from them. They show Scotland so consistently and decisively in advance of her sister nations that if the figures related, not to examination successes, but to observations in the physical world, one would suspect the existence of a natural law. What factors are at work weighting the scales so markedly in favour of Scotland in this matter we prefer for the present to leave others to discuss. They clearly require investigation at the hands of English—and Irish—technical educationalists.

Rail and Road.

IN our issue of last week we suggested to the four railway companies that they should print and circulate by the million pamphlets describing the principal details of railway management and operation, so that the critics might be deflected from the continued use of inaccurate and incomplete information. We still hope that the railways may give consideration to that suggestion, and we note that they have now gone a step towards it by making available at all railway stations and offices a booklet entitled "Fair Play for the Railways." As the title implies, the subject dealt with is Road Competition, but many striking figures concerning railway operation are included. We observe, to take an example, that every weekday 200,000 persons travel to and from London termini in a single rush hour alone. "What," asks the booklet, "would be the state of the roads and streets if an attempt were made to carry these passengers in motor coaches?" The railways estimate that they lost in 1930 by road competition no less than 16 million pounds in net revenue by contrast with 1924. In another place they have divided this loss into 10 million pounds for goods and £6 million for passengers. We must admit that figures such as these, which must obviously be based on presumptive estimates, from an earlier year, are not very convincing, but allowing for statistical exaggeration, the fact remains that millions of people who might travel by train now do so by road vehicles. Now, still quoting from the booklet, 40 million pounds of public money are spent annually on the roads of the United Kingdom, to say nothing of twenty more millions drawn from the Road Fund. Towards this £40 million the railways subscribe, whilst road transport does not. Moreover, road transport has free use of "the enormous capital amounting to hundreds of millions spent out of public funds on the construction of 177,000 miles of public highways." The railways claim that all road users, themselves included, should pay their share of the expenditure on roads in proportion to the use they make of them. "This," says the booklet, "would do no more than place commercial motor transport on the same footing as the Railway Companies, who have to meet the whole cost of constructing, maintaining, policing, and signalling their railways," and, moreover, would relieve the taxpayer of the bulk of his contribution of £40 million per year. The suggestion is not a new one, but it is as difficult now to see how it could be organised as it has ever been. Already £20 million derived from licences on motor vehicles go towards road expenses, and, in a sense at least, the petrol tax, which yields some £32 millions a year, may be said to contribute to road costs. But, looked at in a large way, the problem is not simply to deal equitably with the railways, but to secure to the country the best possible and the cheapest form of transport. That end will not be achieved if the facilities enjoyed by road transport compel the railways to increase their charges; neither will it be achieved if restrictions on road transport deprive the public of the advantages which in certain circumstances it provides. To find a *via media* between the rival claims will, as we said last week, call for the exercise of the highest statesmanship, not only in this, but in other countries which are faced with the same problems.

Literature.

Jane's Fighting Ships, 1931. Edited by OSCAR PARKES, O.B.E., M.B. London: Sampson Low, Marston and Co., Ltd., 100, Southwark-street, S.E. 1. Price 42s. net.

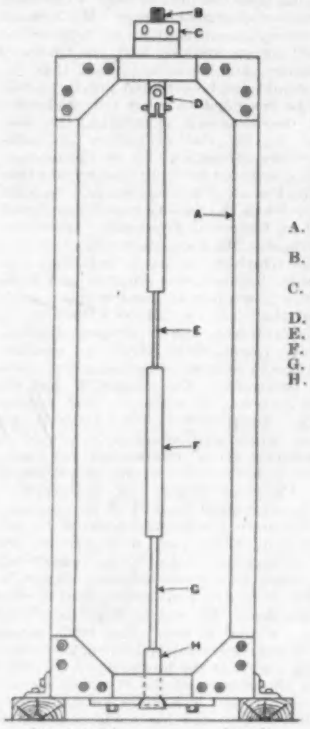
FOR the past thirty-five years "Jane" has held an unchallenged position as the only illustrated encyclopædia of the world's navies, and, notwithstanding the limited naval construction during the past year, the new edition is full of interest. With the assistance of the various Admiralties and correspondents abroad, the editor has successfully compiled a full and authentic record of all recent developments in the sphere of naval shipbuilding. With but few exceptions views are given of every fighting ship or class of any importance irrespective of nationality, with all primary details in the concise practical manner typical of the book. In the British section there are but a few interesting additions to make up for the removal of the four "Iron Dukes," "C" cruisers "S" destroyers and "L" submarines. The chief of these is a spirited impression, probably by the pencil of the editor, of the appearance of the new cruiser "Leander," launched in September last; there are also some fine views of the "Hood," taken since her refit. Much of interest is to be found in the French section. Here we find the "Algerie" with her conning tower mast, the "Foch" with a striking foremast, and some excellent photographs which more than justify the bizarre appearance of the 'Commandant Teste" suggested by her plans. The triple mounting system is being introduced into the French service by the "Emile Bertin," whose plans show her to be a cruiser fitted for mine sweeping. The new submarine cruiser "Surcouf," the appearance of which has been kept such a close secret, is shown for the first time published in a frontispiece with the permission of the Ministry of Marine. The Italians are still improving upon the speed of the "Conditticri" class of 40-knot cruiser, and an engraving is given of the "Zara" as finally completed without the tiers of bridges around the foremast. Japan appears to be embarking upon a large six-gunned cruiser programme, and her latest destroyers of the "Fubuki" class are "probably," in the opinion of the editor, "the most efficient afloat in general all-round qualities."

There is much of interest to be found in every section of the book, and we cannot trace any instance of a fighting ship which has been launched or refitted during the past year—no matter how small—failing to receive careful attention. Unlimited trouble must have been taken in preparing this volume, and it is a credit to the technical knowledge, judgment, and industry of all connected with its production.

An Accelerated Test for the Determination of the Limiting Creep Stress of Metals.*

By W. BARR and W. E. BARDGETT, B.Sc.

THE behaviour of metals under stress at elevated temperatures is a subject which has attracted much attention during recent years. The engineer has already made bold advances into the high-temperature field in steam-power plant, and in plant for the new processes of chemical synthesis; but the limit of the advantages to be gained in this direction has by no means been reached. Future



A. Rigid rectangular frame.
B. Round bar threaded at one end.
C. Nut for applying the stress.
D. Universal joint.
E. Test piece.
F. Connecting-rod.
G. Calibrated weigh bar.
H. Round bar cup-shaped at one end to give axial loading.

FIG. 1—DIAGRAM OF APPARATUS

developments will, however, depend largely on the metallurgist, who must keep pace with the urgent demand for data which can be used for purposes of design, besides providing improved heat-resisting materials at an economical cost. One of the greatest handicaps to progress along these lines is the difficulty of obtaining reliable data concerning the ability of metals to carry stresses without deformation at high temperatures. This difficulty arises owing to the change from a condition of elasticity as ordinarily understood to a state of viscous flow, whereby continuous deformation or "creep" may proceed at very small rates.

The importance of the time factor in creep tests and the experimental difficulties involved in dealing with it are well known. Creep tests are generally based upon time-extension observations over prolonged periods on test pieces carrying constant loads at constant temperatures. For any one temperature it is necessary to use several test pieces carrying different loads, and to determine in each case the rate of creep at the end of the test period. From this series of creep rate values a limiting creep stress is estimated for a certain arbitrary small rate of creep. These limiting creep stresses are not intended to be taken as safe stresses, since they may be accompanied by considerable plastic deformation. Safe stresses can, however, be derived by the introduction of a factor of safety which is usually specified. Tests of this nature, while providing data of fundamental value, require several months to carry out, and are quite beyond the scope of ordinary laboratory practice. It is only to be expected, therefore, in view of the wide field which remains to be explored, that there should be a desire for some form of accelerated test which will provide reliable creep data. Such tests must necessarily be confined to creep measurements in the initial stages. The problem then becomes one of deciding on an arbitrary rate of initial creep which is so small that any subsequent creep will be negligible so far as practical permanence of dimensions is concerned. It is known that this involves the detection of very small strain, particularly at higher temperatures. Therefore, the shorter the duration of the test the greater will be the refinements of measurement required to give reliable results. Several methods have been suggested, in most of which observations are made on constantly loaded test pieces, and in which it is necessary to carry out a search for the stress value corresponding to the arbitrarily chosen creep rate. In the form of accelerated test devised by the authors, on the other hand, the novel procedure adopted eliminates searching, and enables the stress value to be obtained in a period of forty-eight hours. Simplicity of apparatus and ease of manipulation have been aimed at, and it is believed that the test offers many advantages in this respect. It will be shown from the results of tests given in this paper that the stress values obtained represent a close approximation to safe stress values.

The Accelerated Creep Test.—The test depends on the measurement of the diminishing rate of creep in a stressed test piece by means of a steel weigh-bar, so that the creep of the test piece is accompanied by a proportionate decrease in the applied stress.

A diagram of the apparatus is shown in Fig. 1, and three units assembled for test are shown in Fig. 2. A test piece 6in. long and 0·25in. diameter is heated by means of a resistance-wound furnace 24in long, the winding of which is made close at each end of the tube, so that the variation of temperature along the test piece does not exceed 2 deg. Cent. The temperature is controlled to within $\pm 0{\cdot}5$ deg. Cent. by means of a McLaren thermostat located in the winding of the furnace. This type of thermostat operates on the principle of the difference in expansion between a silica rod and an outer nickel-chromium casing, the total current being switched off and on at approximately regular intervals. In order to obtain the required limits of temperature control under these conditions, it was found necessary to introduce a thick metal sleeve between the test piece and the furnace wall. The sleeve is made from a bar of non-scaling steel about 12in. long, having a hole drilled through the centre large enough to allow the test piece to enter. This arrangement efficiently damps the light temperature oscillations due to the action of the thermostat.

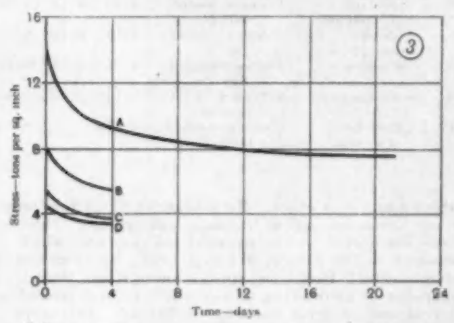
The extension of the weigh-bar is measured by means of an extensometer consisting of an Ames dial gauge in conjunction with a simple lever device. The weigh-bar and extensometer are accurately calibrated in a tensile-testing machine. One division of the dial is equal to a stress of 0·006 ton approximately, and since readings can be taken to one-quarter of a dial division this is equivalent to 0·0015 ton approximately. It has been determined experimentally that the extension of the test piece corresponding to this value of stress decrease is 7×10^{-6}in. per inch approximately.

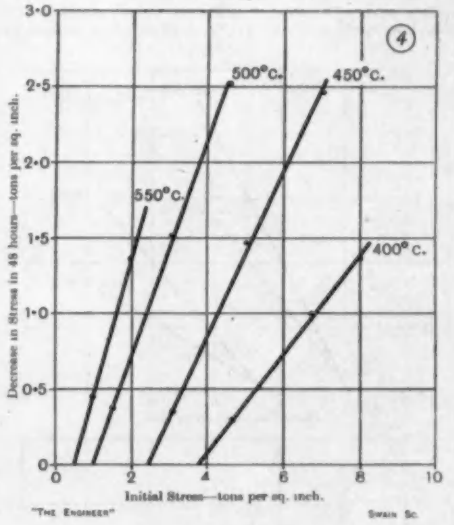
Stress is applied by turning the screw C, Fig. 1, and the actual stress on the test piece is known from the extension of the weigh-bar. Should any creep take place in the test piece, this is immediately indicated by a decrease in stress as shown by the extensometer. Consider a test piece stressed to 14 tons per square inch, say, at 500 deg. Cent., well within the creep range; the test piece creeps fairly rapidly at first and there is a corresponding rapid decrease in stress. As the stress decreases, the rate of creep diminishes, and a curve of the form shown in Fig. 3 is obtained. If a new test piece is stressed, at the same temperature, to the remanent stress of the preceding test, it is found that it shows an initial rapid decrease in stress, which, however, takes place at a lesser rate than the initial stress decrease in the preceding test—see curve B, Fig. 3. Curves C and D at still lower initial stresses show a decrease in stress, but at a correspondingly decreasing rate.

After carrying out a preliminary series of tests along these lines, it was found that the initial stress was approximately proportional to the decrease in stress in a given time. Hence, by plotting the decrease in stress against the initial stress, the straight line drawn through the points, if produced, cuts the initial stress axis at a certain value, representing the stress which will give no measurable decrease in stress in the period of the test. As previously explained, this must correspond to a total creep of less than 7×10^{-6}in. per inch for the period of test.

After numerous experiments, it was found that a period of forty-eight hours gave the best combination of accuracy and limited test duration; consequently, this period was standardised for all tests. On this basis, the rate of creep will be less than $1{\cdot}45 \times 10^{-7}$in. per inch per hour approximately. Since this rate of creep is likely to be very much greater than the average rate over extended periods, there are obviously great practical advantages in being able to estimate accurately and rapidly the probable limiting creep stresses corresponding to such a low rate of creep.

A series of initial stress-decrease in stress curves obtained for a 0·11 per cent. carbon steel at various temperatures is shown in Fig. 4, from which it will be observed that the rate of decrease in stress as indicated by the slope of the curves increases with the temperature. This is due to the diminishing influence of strain-hardening on the rate of creep as the temperature rises.





FIGS. 3 AND 4

From the nature of this test it will be understood that for any given conditions of temperature and initial stress the rate of decrease in stress—in tons per square inch—will depend upon the dimensions of the test piece. In order to determine the influence of this factor on the results obtained, comparative tests were carried out at temperatures of 400 deg. and 500 deg. Cent., using test pieces 6in. long by ⅛in. and ¼in. diameter respectively. All the test pieces were cut from the same bar of steel—0·23 per cent. carbon, 1·67 per cent. manganese—and were all in the fully annealed condition. It was found that the limiting creep stress values obtained—Table I.—agreed to within fairly close limits at each temperature, any variation being within the range of experimental error.

TABLE I.—*Comparative Limiting Creep Stresses with ⅛in. and ¼in. Diameter Test Pieces.*

Diameter of test piece, inch.	Limiting creep stress, tons per sq. inch. 400° C.	500° C.
⅛	4·5	1·8
¼	4·2	1·7

Referring to the curves obtained in the above tests—Fig. 5—it will be observed that although the two curves for any one temperature, cut the initial stress axis at practically the same point, the slope of the curves is different, being greater for the ¼in. diameter test piece. The reason for this is made clear from the data given in

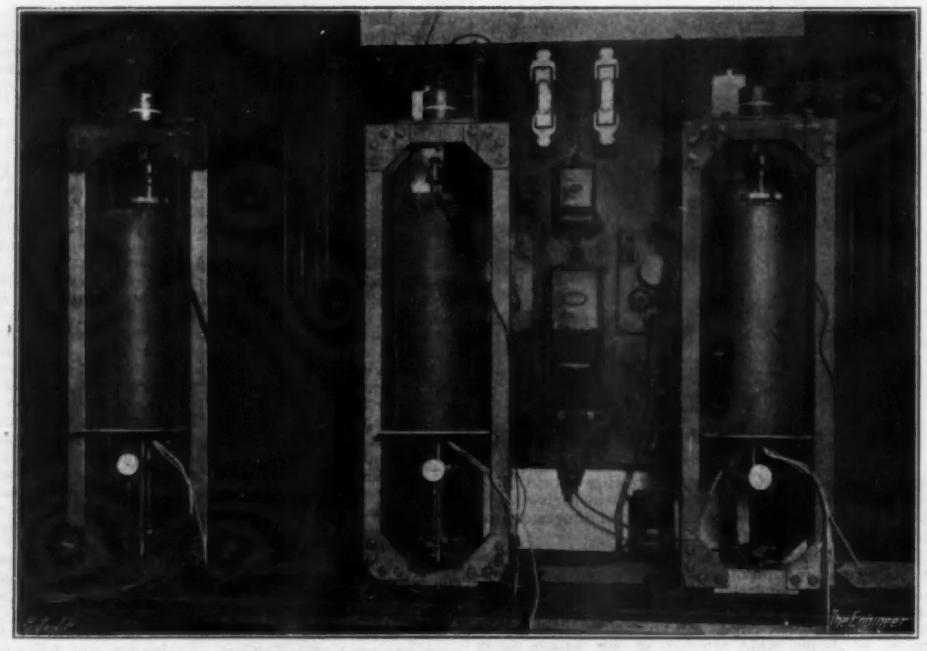


FIG. 2—THREE UNITS ASSEMBLED FOR TEST

* The Institution of Mechanical Engineers. February 19th.

Table II.; the ¾in. diameter test piece has to extend further than the ¼in. diameter test piece for a given decrease in stress. Similar reasoning will show that for test pieces of the same diameter and different lengths, the rate of decrease in stress will be greater, the longer the test piece.

TABLE II.—*Relative Extensions of ¼in. and ⅜in. Diameter Test Pieces at 400° C.*

Diameter of test piece, inch	¼	⅜
Initial stress, tons per sq. inch	9·5	9·5
Extensometer reading, divisions	73·0	163·75
Final stress, tons per sq. inch	8·04	8·71
Extensometer reading, divisions	61·75	150·25
Decrease in stress, tons per sq. inch	1·47	0·79
Extensometer reading, divisions	11·25	13·5

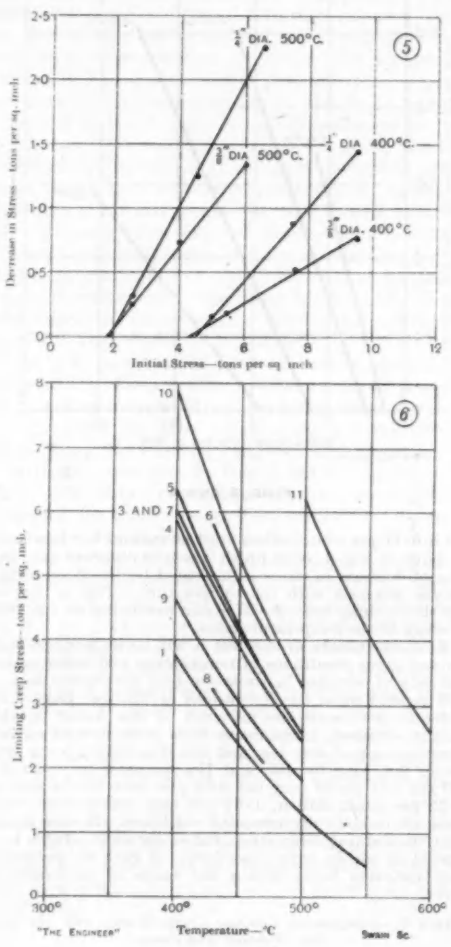
The straight-line relationship between initial stress and stress decrease necessitates the determination of only two points on the curve, but the authors recommend a third point as a check. To save time, three test units are run simultaneously at the same temperature. The test pieces are heated to the required temperature, which is measured to the nearest 0·1 deg. Cent., by means of a potentiometer. Before the application of stress, the whole apparatus is allowed to adjust itself to the prevailing internal and external thermal conditions. This usually requires several hours. A different initial stress is then applied to each test piece. No further observations are necessary until the end of the 48-hour period, when the remanent stress on each test piece is determined. The temperature of the test pieces is recorded on a thermograph during the course of the test, and it is essential that all temperatures, including that of the room, be at their exact original value when the final stress values are observed.

Discussion of Test Results.—Representative limiting creep stress values obtained by this test for a variety of steels are given in Table III. and Fig. 6. These refer mostly to low alloy steels with which the authors have been chiefly concerned. While it is not the purpose of this paper to discuss the relative merits of different steels, it is interesting to observe from the data presented that small amounts of molybdenum have a very pronounced effect in raising the limiting stress of low carbon steels. Compared with the other elements tried, molybdenum offers the greatest advantages in this respect.

Comparison of creep data obtained by different investigators is at present a matter of considerable difficulty, owing to diverse methods of testing employed. The authors have, however, been able to carry out an interesting comparative test through the co-operation of Mr. R. W. Bailey, who supplied for the purpose a sample of a medium carbon steel which he had thoroughly investigated himself. This sample is No. 2 in the list given in Table III. It will be observed that the limiting creep stress value obtained by the authors for this steel at a temperature of 400 deg. Cent. is 4·2 tons per square inch. Referring to Mr. Bailey's test on this steel, carrying a constant load of 4 tons per square inch at 400 deg. Cent., after a period of 12,000 hours, the total deformation of the test piece due to creep was only 0·000264in. per inch. Most of this deformation occurred in the early stages of the test. The rate of creep at the end of the test period is reported to have decreased to 5×10^{-8}in. per inch per hour.

TABLE III.—*Limiting Creep Stresses of Several Steels between 400° C. and 600° C.*

No.	Steel.	Condition.	Analysis.							Limiting creep stress, tons per square inch.				
			C.	Mn.	Si.	Ni.	Cr.	V.	Mo.	400° C.	450° C.	500° C.	550° C.	600° C.
1	Mild	Furnace-cooled, 900° C.	0·11	0·56	0·01	—	—	—	—	3·8	2·4	1·0	—	—
2	Medium carbon	—	0·4	—	—	—	—	—	—	4·2	—	—	—	—
3	Molybdenum	Furnace-cooled, 850° C.	0·29	0·57	—	—	—	—	0 50	6·0	4·1	2·4	—	—
4	Carbon-molybdenum	Furnace-cooled, 820° C.	0·44	0·41	0·21	—	0·34	—	0·63	5·9	4·0	2·3	—	—
5	Chrome-molybdenum	Furnace cooled, 820° C.	0·375	0·63	0·28	—	1·25	—	0·65	6·3	4·2	2·4	—	—
6	Nickel-molybdenum	Furnace-cooled, 860° C.	0·15	0·43	0·08	2·81	—	—	0·35	—	4·8	—	—	—
7	Silicon-molybdenum	Furnace-cooled, 860° C.	0·16	0·48	0·51	—	—	—	0·34	—	4·1	—	—	—
8	Nickel-vanadium	Furnace-cooled, 860° C.	0·10	0·45	0·07	2·83	—	0·20	—	—	2·6	—	—	—
9	Manganese	Furnace-cooled, 810° C.	0·23	1·67	0·11	—	—	—	—	4·6	3·1	1·8	—	—
10	Stainless iron	Annealed 750° C. 2½ hours	0·10	0·42	0·49	—	15·2	—	—	7·9	5·3	3·2	—	—
11	Austenitic stainless	Water-quenched, 1100° C.	0·175	—	0·53	9·1	16·1	—	—	—	—	6·2	4·1	2·6



FIGS. 5 AND 6

Further comparison of data is possible in the case of the 1·67 per cent. manganese steel—No. 9, Table III.—samples of which, normalised at 830 deg. Cent., have been tested by the National Physical Laboratory. The curves obtained by the latter for creep limit are shown in Fig. 7, on which has been superposed the authors' limiting creep stress values for the same steel in the fully annealed condition. The National Physical Laboratory creep limit is based on a rate of creep of 10^{-6}in. per inch per day, and one-third of the stress corresponding to this rate of strain is recommended by Gapsell as a safe stress.

The evidence afforded by the foregoing comparative tests confirms the authors' view that the limiting creep stresses obtained by this method of testing approximate closely to safe stresses—that is, stresses which give negligible initial deformation and permanence of dimensions for long life.

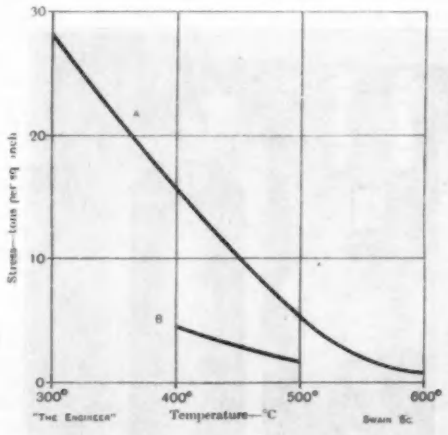


FIG. 7

Concluding Remarks.—As a means for the rapid discriminating examination of steels of varying composition, the authors have found this accelerated creep test to be of great service. Moreover, the data obtained are of practical value to the engineer who desires to know for purposes of design what stresses he can impose upon the metal at high temperatures without deformation. The apparatus required is simple in construction and comparatively easy to manipulate, observations of stress by means of a weigh-bar external to the furnace offering many advantages in this respect.

The possibility of structural changes—which may affect the rate of creep—proceeding slowly at high temperatures, has, it is believed, been amply provided for in the case of the low alloy steels referred to in this paper by testing the steel in the fully annealed condition.

In conclusion, the authors wish to record their appreciation of the permission given by the directors of Messrs. Colvilles for the publication of this paper.

SIXTY YEARS AGO.

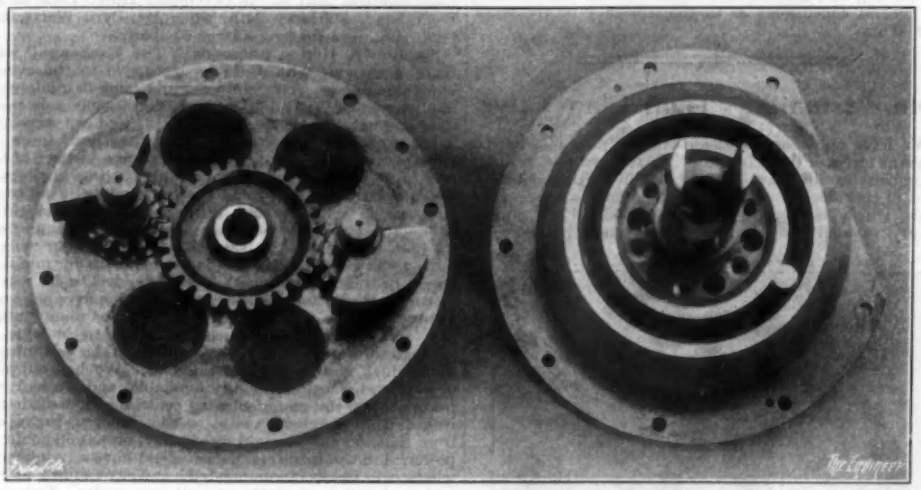
THE proceedings at the first meeting of the newly formed Society of Telegraph Engineers were reported in our issue of March 1st, 1872. The meeting was held at the Home of the Institution of Civil Engineers, and was presided over by Mr. C. W. Siemens. It was recorded with satisfaction that the membership of the new body was already rapidly approaching 200 in number, and that among the names on the roll were those of Wheatstone, Cooke, Thomson, and Tyndall. In his inaugural address, the President took a very broad view of the range of subjects which might properly be regarded as coming within the Society's field. Indeed, even at that very early date, it is evident that the vision of the founders of the Society was broadening from the limited field of electrical telegraphy to the whole of electrical science. Mr. Siemens pointed out that electricity was at that time not represented by a separate learned society ranking with the Chemical or Astronomical Society, and therefore urged that the Society's attention should not be confined purely to telegraphy, but should be extended to cover the production of alternating and direct-current electricity, the laws regulating electrical waves, the utilisation of feeble currents, and many other subjects which for the moment, were more intimately connected with physical science than with telegraphy. The President's vision reached its fulfilment some years later when the Society transformed itself into the Institution of Electrical Engineers. Discussing purely telegraphic subjects, Mr. Siemens commented upon the fact that it was relatively easier to establish telegraphic communication between this country and India or America than between one part of London and another part. He considered that there would be a limit to the applicability of the electric telegraph in populous districts, and that the Society might with advantage examine whether some other agency of inter-suburban communication might not be preferable. He suggested that the pneumatic tube transmission of messages, first applied by Latimer Clark, and subsequently modified and extended by others, would be found well adapted to provide a means of rapid interchange of intelligence in towns. In the same issue we published the second of a series of articles, entitled "Practical Papers on Telegraphy." The subject was of great topical interest at the moment, but, if we may judge from the ground covered by our articles, and the style in which they were written, the popular knowledge concerning telegraphy and electricity in general was in a highly nebulous condition. Before he could attack his subject seriously, our author had to clear away many mistaken ideas. He had to dispel the belief that electricity was "a kind of fire," that birds sitting on a telegraph wire were killed or injured during the transmission of a telegram, and that the humming of telegraph wires was caused by the passage of the electrical current along them. He evidently felt himself in some difficulty by reason of his inability to tell his readers in simple language exactly what electricity was. All he could do in that direction was to state that there was reason for believing that electricity was not a force like gravity inherent in all matter. He also explained that the advice of a very high authority that learners might think of a current of electricity as something like the passage of a stream of water along a pipe should be accepted with caution. The analogy, he said, was at fault because no known earthly means had been able to detect any ponderability in electricity.

THE INSTITUTION OF CHEMICAL ENGINEERS.

THE Institution of Chemical Engineers has now completed the tenth year of its existence, and continues to grow, alike in size and in the importance and volume of its work. It now numbers 700 members of all grades. During the past year it suffered two heavy losses by the death of Sir Arthur Duckham, a Past-president, and by the death of Professor J. W. Hinchley, who, since the incorporation of the Institution in December, 1922, up to the time of his death last August, had acted as its Honorary Secretary. The Institution now works under a financial arrangement with the Chemical Engineering Group of the Society of Chemical Industry and with the Diesel Engine Users' Association, whereby it shares with those bodies the services of a common secretarial staff and secures other benefits and economies. Among its other activities the Institution maintains an Appointments Bureau. During the past year, except for its inability to satisfy the requirements of three important positions overseas, for which oil milling experience was necessary, the Bureau succeeded in securing a very high proportion of successful appointments. A decided tendency has been noted for employers whose requirements have previously been satisfied by the Bureau to return to it when vacancies again occur. The Institution is one of the several bodies which are interested in the proposal for the establishment of a central headquarters in London for scientific and technical societies. The amount subscribed by the various societies interested in that scheme was considerable, but was insufficient to permit the taking up of the options on the proposed site in Westminster. The options were, therefore, allowed to lapse, and as a result of the prevailing acute financial and industrial conditions, it was considered undesirable to proceed with the scheme for the present. It is hoped, however, to bring the scheme to fruition in the near future. On Friday of last week, the Institution held its tenth annual corporate meeting in London. In the morning, following the transaction of Institution business, the President, Mr. W. A. S. Calder, delivered an address on "Control of Industry." After an informal luncheon Dr. Ezer Griffiths read a paper on "Thermal Insulation." In the evening a company of about 250 ladies and gentlemen assembled at the Hotel Victoria for the annual dinner. The toast list included "The Institution of Chemical Engineers," proposed by Sir Harry McGowan, and responded to by the President; "The Guests," proposed by Viscount Leverhulme, President-elect, and replied to by Sir John Cadman and Lieut.-Colonel W. H. Hatchard-Smith, Prime Warden of the Company of Dyers, and "The President," proposed by Mr. J. Arthur Reavell.

A NEW VARIABLE TRANSMISSION GEAR

MR. H. F. HOBBS, ADELAIDE, AUSTRALIA, ENGINEER

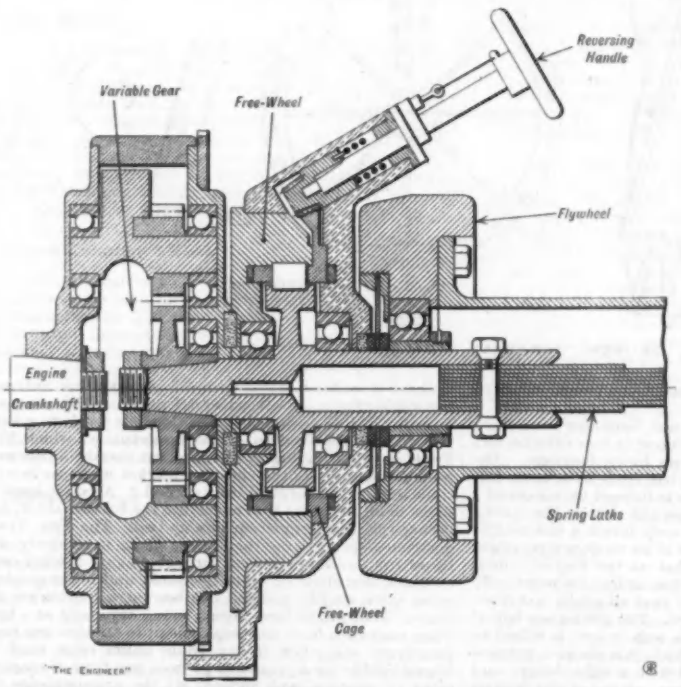


An Automatic Variable Transmission Gear.

IT has long been recognised that the conventional form of gear-box and clutch, as applied to a motor car has many failings. Only recently, however, has the problem of finding some other method of connecting the engine to the road wheels been attacked with any success. To-day we have the fluid fly-wheel and the epicyclic self-changing gear-box coming into favour. While the epicyclic gear-box still gives no more than a small number of ratios, this disadvantage is not so great as might at first be supposed. The fluid fly-wheel takes the place of the clutch connecting the engine to the wheels in a more flexible manner. Then there are gears of the Constantinesco and Spontan type, described respectively in our issues of June 13th, 1924, and November 29th, 1929.

Another solution to the problem has been developed by Mr. H. F. Hobbs, of Adelaide, Australia. His gear is illustrated by engravings and a drawing on this page. It is automatic in operation, providing a low gear ratio when the resistance to the motion of the car is high, and a direct drive when the car is travelling fast against light resistance. At all speeds it automatically adjusts the gear ratio to suit the relation between the resistance to motion and the power developed by the engine.

Between two discs separated by a ring distance piece and bolted together, are mounted three gear wheels. The engraving above shows one of these discs with the gear wheels mounted upon it. The discs are attached to the crank shaft of the engine, while the large central gear wheel is carried by a ball bearing at the centre of the disc furthest from the engine. The two planet gears are carried in ball bearings in both discs, and themselves support out-of-balance weights. If the central gear is held stationary whilst the discs revolve, the planet gears will rotate, carrying round the out-of-balance weights, which are so arranged that both masses travel outwards from the centre of the disc together and inwards again in unison. Assuming that the disc is rotating clockwise then, when the weights are travelling inwards, a force will be exerted by the centrifugal acting upon them to drive the central wheel in a clockwise direction, and when the weights are travelling outwards, to drive the central wheel in an anti-clockwise or reverse direction. By arranging between the central wheel and the rear axle of the car, a free-wheel mechanism, the rotation transmitted to the wheels can be confined to one direction. Before leaving the subject of the gear itself for that of the free-wheel mechanism, it should be noticed that even should the central wheel be held—corresponding to the application of the brakes when the car is stationary—the engine is still free to rotate. At the other end of the scale of gear ratios—the car travelling at speed—the out-of-balance weights will take up the outermost position and the central gear will rotate in the same direction as, and as fast as, the disc. The weights take up this position owing to the fact that the resistance of the car to motion is not great enough to overcome the centrifugal forces tending to hold the weights as far as possible from the centre of the disc. Thus at one end of the scale direct drive can be obtained while at the other there is an exceedingly low gear ratio. Intermediately, the gear ratio depends upon the relation between the resistance of the car to motion and the power and speed of the engine.

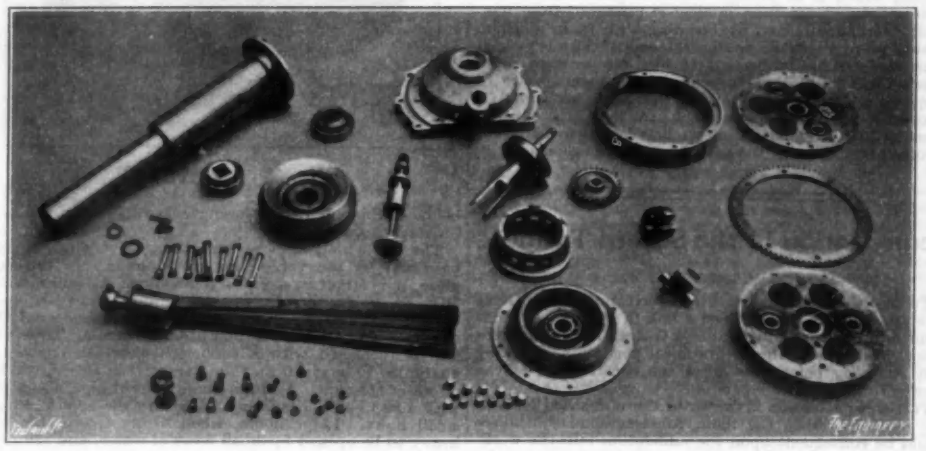


SECTION THROUGH GEAR AND FREE-WHEEL

Much depends upon the design of the free-wheel mechanism. This device must be of such a design that either the forward or the reverse directional impulses of the gear can be selected to drive the car. Part of the mechanism can be seen in the engraving above, while a section through the whole gear and free-wheel is given in a drawing. Another engraving, shows the various parts laid out for inspection. The central gear wheel of the gear-box is carried on an intermediate shaft forked at the rear end and formed in the centre into a wheel. From the engravings it will be seen that this wheel can rotate within a casting which, on its inner face opposite to the periphery of the wheel, is shaped into a cam-like form. Between the wheel and the casting and carried in a cage are a number of rollers. The casting is bolted firmly to a casing, itself fixed to the frame of the car, and is consequently immovable. The cam on its inner face is so arranged that when the wheel rotates the rollers tend to jam between the cam and the wheel itself. The cage in which the rollers are carried can be rotated into such a position that when the wheel turns in one direction the rollers jam, and consequently stop the motion, and when the wheel turns in the other direction the rollers revolve freely and offer no resistance. In the drawing, there can be seen at the top a hand wheel on a shaft carrying at its lower end a pinion engaging with the teeth on the end of an arm attached to the cage. By means of this hand wheel the position of the cage can be altered to allow the wheel to rotate in the forward or reverse direction at will.

At speed, the impulses are transmitted by the gear in such rapid succession that to all intents and purposes the drive is continuous, but when starting from rest the impulses are less rapidly transmitted. In consequence the connection between the gear and the road wheels must be flexible in order to allow the road wheels to rotate smoothly while the central wheel of the gear is alternately running slowly and rapidly. This flexibility is provided by connecting the fork at the end of the wheel of the free-wheel mechanism to the universal joint of the transmission shaft by means of metal spring laths. Covering the laths is a tube, also connected to the universal joint, and fixed at the forward end to a fly-wheel which serves to damp out the succession of impulses into a steady drive.

It is claimed that this form of transmission can be applied to every type of engineering device in which mechanical transmission is required and is particularly suitable where the load to be carried is of a variable nature. The mechanism, which has been named the Hobbs inertia gear, has been fitted to a 7 H.P. Austin car, which has now completed several thousands of miles of running. No defect has become apparent. We understand that a company has been formed in Adelaide to place the device on the market.



PARTS OF VARIABLE GEAR FOR MOTOR CAR

The Salerni System of Low-Temperature Carbonisation.*

ELEVEN years ago Signor Piero Salerni enunciated the principle that to ensure efficient transference of heat applied externally to a charge of coal in a process of low-temperature carbonisation, comminution and continuous agitation of the charge is essential. A series of experiments made by him in 1919 in England, and in 1920 on an industrial scale at Aubervilliers in France, with a wide range of coking and non-coking coals by the process described in his British patent specification No. 182,601 of 1921, had proved, he thought conclusively, that the time taken to heat to the requisite extent a charge of coal in a finely divided state, by the external application of heat, is, within limits, inversely proportional to the rate of agitation, *i.e.*, to the frequency with which fresh particles of coal are brought into contact with the heating surface, and that, without inordinately rapid agitation, the process had the effect of so materially increasing the output of a retort as to render the production of powdered semi-coke on a large scale commercially possible, despite the serious defect, inherent in the agitation method, that the resultant distillate was polluted with dust. Many years of industrial application of the agitation process at the French Government Mines in the Saar and elsewhere in Europe, in retorts designed by Dr. Edoardo Salerni, have confirmed the principle, the limits of efficiency attained in 1920 remaining unimpaired.

To render low-temperature carbonisation applicable generally to the treatment of all the bituminous coal at present burnt in the raw state, a system is needed in which the charge of coal can be heated uniformly to a temperature no higher than that at which the oil and the smoke-giving constituents are separated from it—about 450 deg. Cent. —in order that most of the gas-forming constituents may be left in the coke, so that it be not robbed to an unnecessary extent of density, calorific value and flaming property, the loss of which involves the consequential further disadvantage of increasing the percentage of ash in the fuel.

* From a paper presented by Signor Salerni to the Third International Conference on Bituminous Coal, held last year in Pittsburgh.

The agitation method is the only practicable means by which an externally heated mass of coal can be carbonised uniformly, as desirable, to a degree sufficient to transform it into smokeless fuel without misuse of any of its gas-producing constituents.

The scope of Signor Salerni's original method was restricted to the production of semi-coke in powdered or granular form, mainly with a view to subsequent briquetting and re-carbonisation—a process involving additional cost and the use of extraneous cementing substances; but the agitation method has since been successfully applied to the manufacture of semi-coke in lumps.

Briefly put, the process consists in heating to a temperature of about 450 deg. Cent. by the external application of heat, in a retort of the revolving drum type, a blend of comminuted coal and semi-coke, so finely ground that its porous structure is destroyed, pitchy fractions of the oil from the process itself being added to the blend. The blend is introduced at one end of the drum, travels through it and is discharged at the other end in the form of coke—introduction, travel and discharge taking place continuously by gravity action. On reaching the temperature at which coking begins, the charge tends, owing to the rumbling action, to form itself into spheroidal blocks in the same way as in other well-known processes of the agitation type. The size of the spheroids formed depends mainly on the degree of agglutinating property of the blend, and this is regulated by the proportion in which coke and oil obtained from the process itself are used in the blend.

The addition of heavy oils to the blend presents the incidental advantage of preventing the raising of dust in the retort, thus removing the cause of one of the great troubles involved by the agitation method of heat transference, namely, distillates polluted with dust.

A recent development is the application of the process to the treatment of non-coking coals even when coking coals are not available for blending with them. This feature widens its scope to the whole field to which it was intended to make it applicable, namely, to the treatment of all the bituminous coal, whether coking or non-coking, which is at present burnt in grates in the raw state. Coke of excellent quality is produced from non-coking bituminous coal by blending with it, in addition to coke powder and the pitchy fractions of the oils yielded from the coal, a proportion of high-temperature pitch somewhat smaller than is used in the manufacture of briquettes. More than half of the pitch so added is recovered during the treatment, so that the expense incurred by the provision of pitch is less than half that involved for binder in the manufacture of briquettes.

Cementation in the Severn Tunnel.*

By RAYMOND CARPMAEL, M. Inst. C.E.

To emphasise the importance of the tunnel to the Great Western Railway Company as a link in its chain of communication between England and Wales, the author gives historical details of the geographical position as affecting that company before and after the construction of the Severn Tunnel.

Particular attention is drawn to the unrealised fears of the promoters that the main constructional difficulties would be consequent upon the infiltration into the workings of water from the river, and it is pointed out that the alteration in vertical alignment of the tunnel to provide additional depth between the river bed and the tunnel heading, which was decided upon after the work had been commenced, created the unanticipated difficulties in the tapping of the great subterranean spring which delayed the opening of the tunnel and involved the railway company in costly permanent pumping to deal with the vast quantities of water.

The subject of the paper is in no way connected with these pumping arrangements, but deals with troubles which have been experienced, not only during the construction of the tunnel, but also on two recent occasions, owing to extensive irruptions of water from the river in the neighbourhood of the Bristol portal. The troubles experienced in 1924 and 1929 were occasioned by the passage of tidal water through "pipes" or faults in the overlying marls. They were overcome by filling the "pipes" from the level of the river bed with bag concrete, &c. The expense was heavy and the method provided no final remedy. It was felt that some more permanent means of guarding against a repetition of these excessive leakages was essential, and that the remedial measures must effect some permanent strengthening, not only of the arch ring of the tunnel, but also of the surrounding strata where they were broken, whether due to the construction of the tunnel or to natural causes. It was decided that such strengthening could only be given by the injection of cement under pressure, and a description is given of the method by which the work was carried out for a length of about 1 mile from the Bristol portal through the disturbed marls to their junction with the solid sandstone rock.

The paper also describes similar cementation work carried out in two ventilating shafts, at Sea Walls and Sudbrook, where, owing to defective mortar in the brickwork, excessive water leakage resulted in undue track corrosion and risk of injury to trainmen owing to the formation and fall of icicles in winter.

It was realised that there were peculiar difficulties in carrying out any work necessitating obstructions within the minimum structure gauge, and arrangements were made to confine all such encroachments to work carried out on Sundays during the winter months.

The air compressors for operating the boring tools, the cement mixing and pumping plants, blacksmiths' shop, &c., were located on a site adjoining the mouth of a ventilating shaft, down which was led a series of mains connecting with a similar series nearly 5 miles in length attached to the tunnel walls and serving the drills and injection holes.

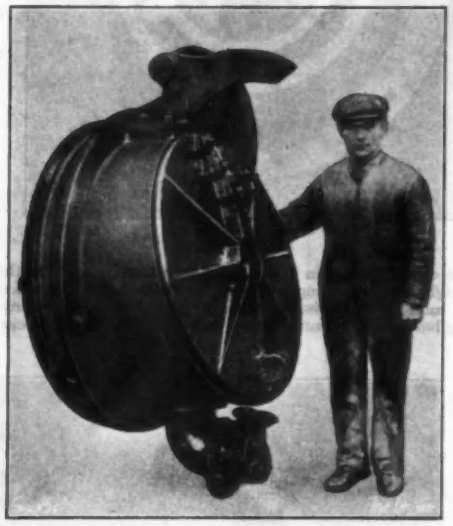
A complete telephonic system was also installed between the plant station, the offices, and the tunnel.

The whole of the drilling, with the exception of certain invert holes, was carried out on Sundays, mainly from portable stages lowered in sections down the ventilating shaft and erected on the running lines. In the main the work consisted of drilling a series of holes through the brickwork of the arch ring and the injection of liquid cement into them. Particulars are given of the extent of the drilling and cementation work, and the author adds his general conclusions as to the efficiency of the work carried out.

* Abstract of a paper to be brought forward for discussion at the Institution of Civil Engineers.

36in. "Ismailia" Tidal Flap Valve.

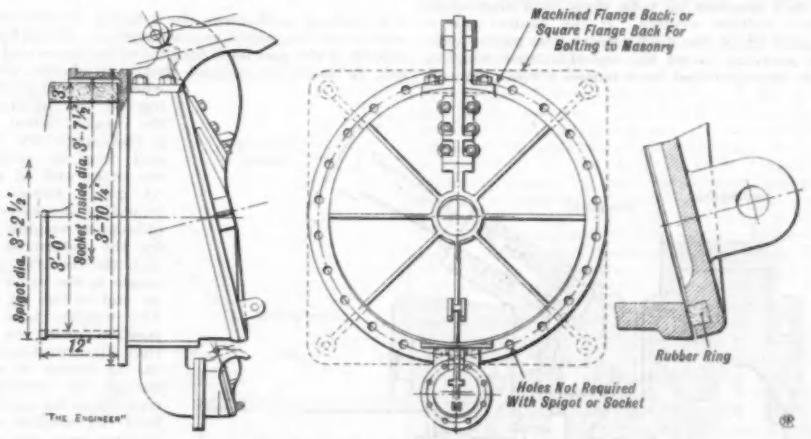
WE have on several occasions in the past referred to different forms of the "Ismailia" tidal flap valve, and the accompanying illustrations show a still further development of this device. The engravings show a water-tight valve, which has recently been installed by the Surrey County Council for discharging into the Thames, just



TIDAL FLAP VALVE

below Richmond Lock, the surface water from the new Chertsey Arterial Road.

The valve embodies several features which were not possessed by the valves previously made. In the first place, it is larger in size, the diameter of its orifice being 36in., as against the 27in. of the largest of the earlier made valves, this increase in diameter having necessitated the employment of a new method of construction. Then, the flap is furnished with a rubber face, which enables a guarantee to be given that the valve, when closed, will let no water through. Again, a small by-pass pipe, also fitted with a flap valve, has been arranged in the invert to pass small flows. Large doors, when firmly closed, are too heavy to be opened by small flows of water, and the provision of a small by-pass has done away with the necessity of having balance weights and other mechanical devices, which are liable to give trouble. Finally, a socket is cast



36-INCH "ISMAILIA" TIDAL FLAP VALVE

at the rear of the valve to allow of the insertion of the spigot end of a pipe.

In other respects the valve is not dissimilar from those which have gone before it. The door or flap rides on two convex surfaces and there are no hinge bearings. The flap is free-seating, and has, as has been said, been furnished with a rubber face, which is formed by means of a rubber ring inserted in a dove-tailed slot in the metal. It is claimed that this ring not only forms a water-tight joint, but also that with it there is no tendency to vibration. It is pointed out, too, that as the flap is round, and without links or hinges, the rim is free for practically the whole of its circumference, so that all sticks and floating matter fall clear as discharged. The guides are bolted to the body of the valve, and the web or arm is bolted to the flap, a form of construction which, it is claimed, permits of great strength being obtained with a light design, and which, in the event of an accident, allows of the broken member being readily replaced without dismantling the body of the valve.

These valves are made for and to the designs of the Ismailia Valve Company, of 17, Victoria-street, Westminster, S.W. 1, by Sir James Laing and Sons, Ltd., of Sunderland.

The London Iron and Steel Exchange.

THE annual dinner of the London Iron and Steel Exchange was held at the Dorchester Hotel, London, on Wednesday, February 24th, when Mr. Cyril Watts, the Chairman, presided over a large company.

Sir Robert Horne, proposing "The Exchange," said there were none who could be insensible to the events now taking place. The figures he was going to quote were familiar to many. In 1931 we imported 600,000 tons more iron and steel than we did in 1913, and we exported 3,000,000 tons less. For a country that lived upon its exports, and for a country that had been a pioneer of the iron and steel industry, for a country whose coal trade depended a great deal upon the iron and steel industry, that was an ominous fact. Whereas in 1913 we exported 2¼ million tons more iron and steel than we imported, in 1931 we imported 1,000,000 tons more than we exported. It was clear that we had to make up our minds in Great Britain to-day whether we intended to be manufacturers of iron and steel or not. There could only be one answer. In the first place, if we could not manufacture iron and steel profitably, we ought not to be able to manufacture anything at all, because of the advantages with which Nature had provided us. We had supplies of coal and ironstone readily available, and we had our ports near to the manufacturing centres. That made the iron and steel industry vital to this country, but apart from that, no nation could live to-day, no nation could be powerful in the world, no nation could have any influence whatsoever unless it commanded a sufficient supply of iron and steel to defend itself under all vicissitudes. Therefore he took it that we must have an iron and steel industry in this country. If that were so, what were the reasons why we had arrived at the desperate position in which we were? If we considered the conditions of competition between this country and other countries, one reason at least became obvious. If we compared our wages with those of a country which supplied us with the greatest proportion of the 3,000,000 tons that we took from abroad last year, it would be found that their wages were only 40 per cent. of ours. For every shilling they paid in wages, we paid 2s. 6d. If we compared the relative income tax, it was seen that for every shilling they paid we paid 3s., and when it was considered what we were bound to spend on social services, according to our present rule, it was seen that for every shilling they paid we paid 15s. That was not a matter of politics. It was a sheer question of arithmetic, and unless all the rules of mathematics were wrong we could not survive under conditions of that kind.

If, then, we had made up our minds to have an iron and steel industry in this country, we had also to make up our minds how we were going to counteract those conditions. A good deal was said from time to time about the lack of efficiency in the iron and steel trades, and no doubt it was possible to find some works in this country which had not up-to-date plant; on that point he would make two remarks. The first was that the most up-to-date plant that had been constructed in this country since the war had not been able to meet the competition he had described, and, in the second place, those who had not been able to keep their plants up to date had been forced into that position by the fact that the tax-gatherer had collected from them all the resources which they could put aside for the purpose of re-equipping themselves. Accordingly, we were forced back to a consideration of those devices which were now receiving the attention of Parliament. Should we have a tariff or should we not? Every other nation in the world except ourselves had defended itself by means of a tariff. The objection that was taken as a rule to a tariff was that it deprived us of the opportunity, which Free Trade gave, of buying in the cheapest market. But were we really buying in the cheapest market when we bought three million tons of steel from abroad? Account must be taken of all the items that came into the balance sheet, and perhaps he might mention one or two. The Free Trade doctrine depended on the theory that, if anybody was thrown out of employment through buying foreign commodities, somehow or other he would find other employment quite readily and did not become a burden on the State. That might have been a sound argument at a time when migration from one employment to another was comparatively easy, but to-day trade union rules made it impracticable for a person to go from one type of employment to another, and, indeed, all the arrangements for unemployment benefit entitled a man to that benefit unless he could get a job in his own particular craft. Those were the conditions that should be considered in relation to the three million tons of imported iron and steel. It could be taken that 100,000 men lost their work through the purchase of three million tons of foreign steel, and was

he wrong in suggesting that the saving on the purchase price of that material, as compared with British, was an average of 30s. per ton? That was £4,500,000, but it cost the country at least £6,500,000 a year to keep the people who had been thrown out of employment, by way of unemployment benefit, and it would actually be cheaper for the country to subsidise the purchasers of steel to the extent of the full amount of the difference between the price of the imported and the price of the British steel and let our people make the steel here. That, however, was only one item of the account, because those people, if they were at work in the steel trade, would be drawing wages to the extent of between £12,000,000 and £14,000,000 in the year. There would also be employed some 40,000 colliers in producing an additional nine million tons of coal for the manufacture of the steel, and that would mean the distribution of £4,500,000 per annum in wages in the coalfields, and those men were at present unemployed and drawing benefit. Then there were the limestone workers and the ironstone workers and the increased transport to carry these commodities for the steel works would be drawing freights to the extent of at least £2,000,000 per annum. Instead of buying our steel in the cheapest market at the present time we were actually buying it in the dearest market in the world.

What were we going to do? There was little doubt, whatever our predilections or prejudices or previous notions had been, that we were emerging into a changed world. It might be right or it might be wrong, but it was certain there would be tariffs in this country. There would be a 10 per cent. tariff on all articles which were not in the free list, and those concerned with the steel trade would have to make up their minds on that and to consider the possibility that the Tariff Commission might impose a higher import duty if it could be proved by the trade that a higher duty was required.

Continuing, Sir Robert said he recalled that at one time he had attempted to help in making arrangements with the foreign Cartel for marketing steel, but the prime difficulty was that the iron and steel industry in this country was not sufficiently organised to speak as a body. In the second place, an obvious difficulty was that we had nothing to offer. Our market was free to other countries under any conditions that existed then, and it was impossible to make any kind of bargain which would be good for us. With a duty on imported steel, however, we had cards to play which we never had in our hand before. Therefore he ventured to suggest that the proper development of trade in this great industry should be along the line of not attempting to cut each others throats, Germany against France and France against England. Germany and France had already come to certain arrangements, which, at the moment, were somewhat precarious; but in those matters it was always possible to be a combined force, and he believed it would be found much more easy to have a tripartite or a quadruple arrangement by taking in Belgium, and to keep it consistent, than was the case when this country was completely outside.

Canadian Engineering News.

Big Winter Hauling Task.

As soon as traffic over winter roads is practicable a start is to be made on the hauling of 800 tons of machinery to the San Antonio mine, where a cyanide mill is being built to treat 150 tons of gold-bearing ore daily. The property of San Antonio Mines, Ltd., in the Central Manitoba field, east of Lake Winnipeg, is expected to be Manitoba's next gold producer with the mill likely to be in operation early next summer. The machinery for the mill is to be transported into the mine from the railway at Pine Falls, a haul of nearly 50 miles.

Deep Mining.

A 1,000,000-lb. cable testing machine, stated to be the largest in existence, is now being installed at Toronto by the Ontario Department of Mines, in a laboratory specially set aside for the purpose. The machine is 12ft. high, is a compound lever affair, and is fitted with autographic recording apparatus and electrically controlled and propelled poise. In the opinion of mining authorities, the purchase of the new machine indicates that the Mines Department believes that Ontario mining of the future will be carried to great depths.

Mining Industry.

The dollar value of Ontario's metallic production for the first nine months of 1931 failed to equal that for the same period of 1930, owing chiefly to lower prices and smaller output for copper and silver and a lessened demand for nickel. Despite these factors, a substantial increase in gold production served to keep the total at such a high figure that the mining industry proved to be the brightest among the basic industries of the province. Besides the gold, the value of platinum was higher, as was also that of the relatively unimportant metals bismuth and selenium, but cobalt, lead and zinc were all lower.

Difficult Salvage Job.

The salving of the Dominion Government dredger "DM-5," which sank six months ago 2 miles east of Three Rivers, Quebec, was completed towards the end of last year. Months of continuous hard work were needed for the salving of the vessel and the cost is estimated at approximately 100,000 dollars. The dredger disappeared beneath the waters of the St. Lawrence last May and sank within twenty-three minutes. On three occasions it was brought out of the water, only to turn over on its port side again and eventually the big floating crane belonging to the Montreal Harbour Commissioners was brought into play. The dredger, the presence of which below the water had been a potential menace to shipping, was one of the largest which had ever been operated in inland waters. It was built in 1926 at a cost of 500,000 dollars.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE

(From our own Correspondent.)

B.I.F., Birmingham.

INDUSTRIALISTS in the Midlands and Staffordshire have this week given their almost undivided attention to the B.I.F. The British Industries Fair at Castle Bromwich, representative of the heavy industries of the country, is of such a character that it cannot fail to impress upon buyers both the variety and the technical excellence of British products. The Fair is dealt with at length elsewhere in THE ENGINEER, and I only intend here to touch upon it lightly and briefly. So comprehensive is the range of exhibits that there can be no doubt manufacturers now consider the Fair a factor of great importance in the exploration of world openings of trade, and all hope, with the Lord Mayor of Birmingham, that this is the beginning of an era of great prosperity for England. At the opening of the Fair the Lord Mayor also said: "Conditions are so hopeful with regard to our fiscal outlook that it is more than likely this may prove to be a great turning point in our industrial history."

Midland Foundrymen.

There was an excellent attendance on Saturday last at the annual dinner of the Birmingham, Coventry and West Midlands branch of the Institute of British Foundrymen, held in Birmingham under the chairmanship of the President, Mr. F. J. Hemming, and the speeches generally were of an optimistic character. It was pointed out by various speakers to the toasts that the Institute had been in existence for twenty-eight years, and that the present membership was 2000, and that in spite of the difficult times it had never shown more life and activity than it did to-day. Three new branches had been formed in the last twelve months, which indicated the Institute was not standing still, but was going forward, and it proved also that foundrymen were anxious to protect those members of their own craft. Mr. R. P. Bethell, President of the Staffordshire Iron and Steel Institute, in proposing the toast of the Foundry Institute, said that during its life remarkable changes in the foundry industry had taken place. The foundry was the most recent of the old arts and crafts to submit to the innovations of modern mechanised production and scientific control. The Institute was to be congratulated on the successful establishment of its educational schemes. The national certificate in ironfounding for the young would-be foundry operative, and the craft certificate for the apprentice moulder and patternmaker would very soon become the recognised hallmarks of foundry training. Mr. Andrew Harley, the President of the Institute, in responding, emphasised the importance of developing technical efficiency in the trade. With the equipment we had to-day, our science and our gift for invention, it ought, he said, to be possible for everybody to be supplied with the comforts that make life happy. Mr. F. J. Hemming, the Branch President, said industry was passing through a period of severe depression, but he felt that out of that depression there would arise something which was going to improve the status of the foundry industry.

High Standard of Steel Rolling.

It was very necessary that by technical education and specialised training the high standard of steel rolling in England should be maintained, said Mr. Phillip Robinson in an address on "Roll Turning and Roll Designing," to the Staffordshire Iron and Steel Institute at Dudley. Mr. Robinson dealt with every phase of rolling mill practice, and said that in England they were compelled to maintain a higher standard of finish, particularly in regard to rails, and were subject to a much more rigid inspection than in the American or Continental mills. For this reason English roll turners and mill experts preferred to leave well alone, and to proceed along the lines which had proved so satisfactory in the past.

Market Position.

Less attention than usual was displayed in the weekly iron and steel market in Birmingham, many of those usually attending being at Castle Bromwich. The call for iron and steel continues slow, and only small tonnages are specified. There is a dearth of inquiry in all departments, and from a market point of view the week has been uneventful. Consumptive requirements are no greater than a week ago, few of the works being more actively engaged than they were. Manufacturers of finished products who have been working largely on foreign semis are faced with a new situation. They can still buy Continental half-products at a lower price than a similar class of material is offered at by British mills. This being so, they hesitate to rely upon the home industry, on the theory that the resultant increase of turnover will bring down production costs to a competitive level. There is much speculation as to the likelihood of the tariff being raised ere long above the 10 per cent. flat rate. Generally, Continental houses quote subject to the buyer paying whatever tariff is chargeable. For the time being, business is withheld, pending developments.

Finished Iron.

In the Staffordshire wrought iron trade there is no marked change. The demand for marked bars is scarcely enough to ensure regular operations, and it is rarely the case that orders are booked more than a week or two ahead. The price is unchanged at £12 a ton at makers' works. Crown quality costs £9 5s., but few Staffordshire makers are prepared to accept this figure which they consider quite unremunerative. It is left for ironmasters from other districts who compete in this market to accept the business. The iron offered, however, is stated to be not up to the Staffordshire quality. Producers of tube strip are working in some cases as much as four days a week, orders being taken at £10 10s. to £10 12s. 6d. per ton delivered. The whole position in the iron trade gives cause for concern.

Galvanised Sheets.

The galvanised sheet industry continues to gain ground, and makers are holding firmly to the higher level of selling prices recently quoted. There is an increasing number of inquiries from overseas customers, and some welcome orders have come to hand from New Zealand. The Transatlantic trade, too, is stated to be developing along more satisfactory lines. It is claimed in some buying circles that good export orders could be placed at rather less than £9 10s., but this figure is the minimum quoted at date. Many makers quote as high as £10 per ton for 24-gauge galvanised corrugated sheets, and there is every evidence of a determined effort on the part of manufacturers to stabilise, if possible, quotations on a higher and more remunerative basis than those which have recently ruled.

Pig Iron.

There is no improvement on the week in the pig iron industry in the Midlands. Specifications for foundry iron are coming in very slowly, and output is greater than consumption. Makers of light castings have fair tonnages of iron booked, but they are accepting delivery of small tonnages only. Other grades of iron are neglected, the engineering foundries being notably short of employment. Derbyshire and Northamptonshire blast-furnacemen have a number of contracts on the books, but in every case delivery is being delayed. Prices are unchanged at £3 2s. 6d. for Northamptonshire No. 3, and £3 6s. for Derbyshire. There is hardly any sale for forge grade iron, which is 5s. per ton cheaper than its respective foundry grade iron. Furnace coke prices are firm, and pig iron producers are making new contracts for fuel on a higher level of quotations than was the case three months ago. The Midland market is not closely concerned with the question of a tariff on foreign pig iron as the cost of carriage from the ports excludes the possibility of competition from this direction.

Steel.

Conditions have not progressed in the steel trade. In no department of the finished trade is regular work possible for more than a few days at a time, while in the half-products section there is ample room for greater output. Most of the steel works are anxiously seeking specifications. Very meagre tonnages are being sold to constructional engineers, and judging from inquiries there is no prospect of improvement in this department of trade in the near future. Schemes of reconstruction have been shelved for the time being. Selling prices of finished material are unchanged. The re-rollers are short of work. They quote £6 12s. 6d. upwards for small steel bars, but even at this price it is difficult to get business. Indeed, lack of demand has in some cases led to further price deterioration. Deals can be made with re-rollers at £6 10s. upwards, while bars rolled from British material range upwards from £7 5s., according to analysis. The minimum for English billets continues on the basis of £5 7s. 6d. Birmingham merchants report a very poor inquiry for Continental material. Heavy tonnages were bought as a precautionary measure against the time when a tariff would be imposed, and with consumption in the works at such a low point these stocks are not being reduced very quickly. Foreigners have advanced their prices by about the equivalent of the tariff, which becomes operative on March 1st. Quotations even with the 10 per cent. added are in almost every case still well below those of English steel masters.

The Late Mr. D. T. Young.

The death is announced as having taken place on January 30th of Mr. D. T. Young, the principal of Messrs. Youngs, of Ryland-street Works, Birmingham. The business will in future be continued under the same style by Mr. Young's executors, and the staff which has been with him for over thirty years will continue to serve.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Export Credits for Engineers.

LANCASHIRE industrial concerns, and engineering firms in particular, are reported to be taking increasing advantage of the facilities of the Export Credits Guarantee Department for financing overseas business. Under prevailing conditions it is not surprising that the Department is restricted from covering risks in India and the Far East, but in other respects virtually all the potential overseas markets come within the scope of the export credits scheme and, with the exceptions referred to, the organisation of the Guarantee Department is said to have now reached the stage where the whole of the export trade of any reputable firm can be covered. The need for long-term credits has been the driving force behind the increasing number of applications from Lancashire firms in the engineering and allied industries, and practical assistance on an important scale in connection with the carrying out of contracts abroad has been rendered.

Non-ferrous Metals.

The improvement noted a week ago in the market for the non-ferrous metals, due in a large measure to New York influences and speculative buying, has almost entirely disappeared. With the exception of tin, which is a few shillings higher on balance than it was a week ago, prices are all appreciably lower. The trade demand for tin on almost all centres has been on a quiet scale, and although, as already indicated, there has been a further slight gain, the highest points touched during the advance have not been maintained. In the copper market the demand at times has been fairly active, induced in a large

measure by the pending duty on imports, although much of the interest has been of a speculative character. After the sharp advance of a week ago standard brands are cheaper by about £1 a ton, and have thus lost the greater part of the ground gained. A certain amount of profit-taking has been in evidence in the case of lead, but the pressure from this direction has been offset to some extent, as in the case of copper, by some additional buying in anticipation of the tariff, and the loss has been limited to about 15s. a ton, values still being fractionally higher than they were a fortnight ago. In spite of the efforts to curtail output, spelter supplies are still appreciably in excess of the present poor demand, and quotations in this section are lower on balance by about 12s. 6d. a ton.

Iron and Steel.

There is still very little of an encouraging nature to report in respect of the Lancashire iron and steel markets. Here and there foundry iron consumers have placed fresh contracts for supplies over the next few months, but these cases have been too rare to satisfy producers, whose order books at the present time are much less satisfactory than they have been for several months. On the other hand, there has been little, if any, falling-off in aggregate deliveries to users in this district, although there is a suspicion that rather more iron is going into stock than there has been of late. Prices are steady on the basis of 67s. per ton for Staffordshire, Derbyshire, and North-East Coast No. 3, all delivered to consumers in the Manchester area, 65s. 6d. for Northants, about 87s. for Scottish, and 81s. for West Coast hematite. There are few bright spots in the steel market. Constructional engineers in some instances are said to be dealing with a few more inquiries, but most of them involve only small tonnages. In any event, up to the present there has been no actual improvement in the position, and the orders which steel rollers are securing from them, as from boiler-makers and locomotive building firms in Lancashire, go only a little way towards assisting in the arrangement of rolling programmes. Makers of special alloy steels report quiet conditions in connection with supplies for the motor car and textile machinery industries, the China trouble having seriously interfered with work on contracts for textile plant for that country.

BARROW-IN-FURNESS.

Hematites.

The position of the hematite pig iron trade of North Lancashire and Cumberland is very unsatisfactory. Owing to the lack of delivery orders the two furnaces at Barrow were damped down last week-end. The activity in the Workington district is about the same. Business all round is quiet and buyers are only covering their immediate wants. The Continental demand is easy. Large stocks of iron are held all through the district. Sales are taking place from these stores in some cases. The demand for hematite iron ore has fallen away and is only of moderate proportions, being mostly on local account. For foreign ores there is a fair call.

Steel.

In the steel trade new business is very difficult to get. Rails are in very small demand, both on home and overseas account, and there is no sign of any betterment. Rails have been rolled at Workington, but the plant at Barrow continues idle for want of orders. The Barrow hoop mills are engaged this week.

Fuel.

There is a smaller demand for fuel, both coal and coke.

SHEFFIELD.

(From our own Correspondent.)

Steel Trade Conditions.

THERE is no improvement to report in the condition of the heavy steel trades, in which February is proving an even poorer month than January. One factor which is interfering with business is the uncertainty as to the nature of the forthcoming tariff proposals. At the open-hearth steel plants production is on much the same scale as it was a month ago. There have been reductions in some cases, but they are balanced by increases in others. There has been a further falling-off in the demand for shipbuilding steel, and business with engineers has also declined. There is much slackness at the rolling mills and forges, particularly in the rod department. For railway supplies the demand is still very much on the light side, and the shops producing axles, tires, and springs could do with a lot more work. On the other hand, a somewhat better tone is to be found in the crucible steel trade, in which, although there is nothing like full activity, several firms are able to report increased business. The stainless steel trade had been showing some falling-off lately, although the volume of its products remained very substantial, but now a steady increase in sales is reported. For the most part, however, the quantities being ordered are individually small. In many parts of the world increasing quantities of road studs are being installed. The export demand for alloy steels is rather better than it has been for a long period.

Tool Trade Improving.

The inquiries for various classes of tools, from consumers who have been in the habit of obtaining supplies from abroad, continue. In addition to the classes of products mentioned in previous reports, the inquiries relate to domestic and school tools and sets, cheaper saws and various woodworking tools, fittings of ladies' bags, manicure sets, razor blades, and carded cutlery. A good many of these inquiries have developed into actual business, sufficient to enable full time working to be resumed at the factories which are in a position to cater for such trade. There are good prospects before the local tool trades, especially when existing foreign stocks are run out. A visit has been paid to this country by Danish merchants, with the object of buying Sheffield goods in place of German. There is but a poor demand for ordinary lines of tools in the engineering, building, and horticultural sections, but some increase of activity in woodworking tools is reported.

Sheffield M.P.'s Revolt.

The present position with regard to steel tariffs is not at all satisfactory to the steel trade of Sheffield, the members of which are keenly anxious to see something done which will really protect them against foreign competition. The seven members of Parliament for the city, who are all Conservatives, have tried hard to secure duties in the interests of the trade, but have had no success so far, and in the House on Monday night they went to the length of voting against the Government. This arose on the question of the exclusion from import duties of iron and steel required for the shipbuilding industry. When the question was put that Clause 11, which provides for this exclusion, should stand as part of the Bill, they forced the House to a division, and, although they were heavily defeated by 342 to 29, they had made their protest, and they propose to repeat it on the Report stage.

English Steel Developments.

The English Steel Corporation is, it is reported, about to concentrate its open-hearth steel production at the Grimesthorpe Works, which were taken over from Cammell Laird and Co., Ltd., at the time of the amalgamation. As a result of this step the melting furnaces at the River Don Works will be disused, and it will be necessary to transfer the mills and other manufacturing plant there and at Penistone to Grimesthorpe, where several open-hearth furnaces are available. Developments at Grimesthorpe also include the laying down of a special plant to press huge steel chassis for large motor lorries and charabancs. A 1200-ton hydraulic press is to be built, and for this purpose a number of big castings are being made. Last week the Corporation despatched one of these castings from the Grimesthorpe foundry to the works of Davy Bros., Ltd., for machining. This casting is a base-plate 35ft. long by 8ft. by 4ft., weighing 37½ tons. It and a crosshead casting of the same length, and weighing 53 tons, which was delivered recently, are the longest castings of this weight ever made by the firm.

Trade with Russia.

Following up my reference of last week to the orders on hand locally for steel works plant for Russia, it is interesting to know that important developments of Sheffield trade with the Soviet are predicted. A director of one of the largest steel works is at present visiting Russia on trade business. As a result of a meeting of firms interested in trade with that country, it has been decided to form a special Russian trade section of the Chamber of Commerce.

Salerni Plant for Sheffield.

The interest which Sheffield has taken in the Salerni process of low-temperature carbonisation has been deepened by the latest announcement on the subject, which was made at the annual dinner of the Midland Institute of Mining Engineers last week. It was at the University that the experimental work was done by which the process was brought to completion, and a few weeks ago Commendatore Salerni announced that the first plant for developing the process would be made in Sheffield. Now it is added that that plant will also be installed in the city. Appropriately enough, the making of this announcement was left to Professor Wheeler, in whose laboratories at the University most of the experimental work was done, and who is President of the Midland Institute. A letter conveying the news had been received from Sir Eric Hambro, who is financing the process. Sir Eric further stated that he proposed to put forward a scheme for the installation of Salerni plants in the future as soon as the first one was proved. It would not affect the finances of the colliery owners or the collieries which desired to have a plant. Commendatore Salerni states that it is hoped to have the first plant working in Sheffield in about six months. Its exact situation has not yet been decided, as the question of the disposal of certain liquids which are produced will have to be considered.

Government Contracts.

The latest list of Government contracts, published in the *Ministry of Labour Gazette*, includes the following with local firms:—Files and rasps, Thos. Firth and Sons, Ltd., Ibbotson Bros. and Co., Ltd., Sanderson Bros. and Newbould, Ltd., English Steel Corporation, Ltd., J. J. Saville and Co., Ltd., S. Osborn and Co., Ltd.; bullet-proof plates, Vickers-Armstrongs, Ltd., and Hadfields, Ltd.; copper nails, Cooper and Turner, Ltd.; knives, Joseph Allen and Sons, Ltd.; table knives, Sheffield Steel Products, Ltd., and Atkinson Bros., Ltd.; forks and spoons, Mappin and Webb, Ltd., Cooper Bros. and Sons, Ltd., and Atkinson Bros., Ltd.

Cutlery and Plate.

While some firms in the cutlery and plate trades are booking fairly good business, there are many bad patches in the industries, and the position of table cutlery, best-quality pocket knives, silver and plated articles, is far from satisfactory. This year so far has been an exceptionally poor one for sales of articles coming under the heading of luxuries. The busy departments are those of scissors, safety razors, cheap pocket knives, and surgical instruments. One of the smaller firms is placing on the market a two-bladed pocket knife of very good quality, which can be sold retail at sixpence. It compares favourably in all respects with the German sixpenny knife, which has had such a great sale in this country in the past. Several Sheffield firms are exhibiting at the British Industries Fair at Olympia, and very satisfactory business was reported on the opening day. Viners, Ltd., booked an order from a big firm of London jewellers for 100,000 oz. of sterling silver hollow-ware and flat-ware. This order, which is valued roughly at £20,000, is thought to be the biggest ever placed in the cutlery section of the Fair. The Wafer Razor Company, which manufactures penny blades at the rate of two millions a month, sold a million to a London firm. Thos. Ward and Sons had large orders for safety razor blades and cutlery from Denmark, Belgium, France, Holland, and Sweden.

NORTH OF ENGLAND.

(From our own Correspondent.)

Iron and Steel Trade Outlook.

ALTHOUGH movement towards restoration of normal conditions in the North of England iron and steel industries is still very slow, there are indications of expansion, and this promises to be quickened to some extent by recent events. While the 10 per cent. tariff on foreign iron and steel is considered quite inadequate, it is welcome, especially as the prevailing opinion is that it will be increased soon to an extent that will stop the dumping of foreign material. Further expansion of inquiry is reported this week, and orders, though still scarce, are not quite so difficult to book as recently. Substantial new contracts must be arranged, however, before much of the idle plant can once more be set in motion.

Cleveland Iron Trade.

The Cleveland pig iron market is steady, with just a little more business passing. Shipments have been on a much improved scale this month. The restricted output is well taken up, and, as early enlargement of production is unlikely, further reduction of stocks is promised. An impetus is expected to be provided by the tariffs, which come into operation next month. Producers declare that prices are more likely to advance than otherwise, and market rates are very firm. No. 1 Cleveland foundry iron is 61s.; No. 3 G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; and No. 4 forge, 57s.

Hematite Pig Iron.

Less satisfactory accounts must be given of the East Coast hematite pig iron trade. In this section stocks are still large, and are responsible to no small extent for the weakness in values, as merchants have considerable quantities and are keen to unload. They have a free hand as to the disposal of their holdings, which is not the case in regard to Cleveland iron, and readily sell at prices below cost of production. Mixed numbers are easily obtainable at 64s. Buyers are still seeking concessions, and declare that they have no difficulty in shading the foregoing quotation.

Ironmaking Materials.

Business in foreign ore has shown a marked falling off for some time past, and consequently imports are on a much lower scale. This month the imports have totalled only 33,806 tons, as compared with 47,106 tons for the corresponding period of last month. Best Rubio ore is nominal at 16s. 6d. c.i.f. Tees. Blast-furnace coke is obtainable at 16s. 6d. to 17s., delivered at the works, but there is little demand.

Manufactured Iron and Steel.

A little improvement in the demand for steel is reported. A few small orders for railway material have been secured, and the order books of sheet makers are better than for some time, while the branches producing constructional steel are fairly well employed. The sections dealing with semi-manufactured material, however, are still languid. Stocks imported to forestall the tariff are so heavy that consumers will have no need to purchase fresh supplies for months to come. Prices are unchanged.

The Coal Trade.

The Northern coal trade is passing through another very quiet time, and in Durham the position is causing anxiety. Trade has been declining since the month began, and the prospects for the immediate future are discouraging. The winter season requirements are practically at an end, for if there was to be any severe weather between now and April, the gas and electricity undertakings have immense stocks, and are not likely to buy more fuel at present. Abroad similar conditions prevail, because of the absence of severe weather. There has been a great deal of lost time recently at Durham pits, and there is more in prospect, for here and there collieries are having to close down pending a better demand. A singularly mild winter, universal industrial depression, and barriers in many countries against imports, are the chief causes of the dearth of orders. In the matter of early shipments, Northumberland is better off than Durham, but forward inquiries are small, and there is a fear that the trade is in for a dull spell. Work at the Northumberland pits is likely to be irregular, and only the operation of minimum prices prevents a slump in values. Best Northumberland steams are quoted at 13s. 6d. and small at 8s. 6d., but overseas customers show no interest. Tyne prime steams move slowly, but hold steadily to 13s. 6d. and small at 8s. Prime Wear steams are steady, owners reporting moderate bookings for prompt. Prices are unchanged at 15s. for large and 12s. for small. Except for a moderate good prompt demand for first-class unscreened bunkers, the prospects for the Durham trade are disappointing. Best bunkers are in fairly good supply at 13s. 6d. to 14s., and other qualities abundant at 13s. Durham gas coals are dull and easy for prompt, and feeling the effects of prompt tonnage shortage. Buyers are able to cover at 14s. 6d. for best qualities. Secondary gas are plentiful at 13s. 6d. Wear prime steams are fairly well booked, and quoted steady for the end of the month at 15s. Durham coking unscreened are neglected, but unchanged in prices at 13s. 6d. to 13s. 9d., and coking small at 12s. 6d. to 13s. 3d. There is now little pressure for coke, and stocks show some increase. Gas coke is offered more freely, but best qualities are unchanged at 19s. Patent oven coke is quiet at 16s. to 16s. 6d., and superior foundry coke at 18s. to 20s. Coke nuts are also offered more freely at 19s. to 20s.

Wearside Optimism.

Orders for Durham nuts secured by a Sunderland firm of coal shippers have given rise to a feeling of optimism on Wearside, and it is thought they may be the forerunners of Sunderland regaining the important connection it had with the South American trade. The nuts are of the type specially used in South America, and it is thought that the recent visit of the Prince of Wales to Argentina and the resulting stimulus to British trade is partly responsible for the placing of the orders in Durham. A few years ago Durham coal was exported to the River Plate in large quantities, but in more recent years Sunderland's share of the trade has been confined to odd cargoes. There is a large quantity of Durham coal waiting to be shipped from the Wear, and an additional factor is that since the new £100,000 staith has been opened, the coal can be handled with remarkable speed. This is considered a strong reason why Sunderland should regain this important connection. The vessels chartered to carry the coal have a tonnage of about 5000, and the destinations are Santa Fe and Montevideo. As well as the cargoes, the vessels will require a big supply of bunker coal for the long trip to the River Plate.

SCOTLAND.

(From our own Correspondent.)

Conditions Unchanged.

THE position in the steel, iron, and coal trades continues without change. Markets on the whole remain featureless, though here and there reports indicate sustained inquiries from overseas, which may eventually mean increased turnover. A better feeling is maintained in certain quarters that the tariff arrangements will soon produce a stimulating effect on industry when the position is more defined and the scheme is in working order. Meanwhile, however, business is, if anything, quieter all round.

Steel.

Steel makers have still to report a shortage in the demand for plates and sections, and a rather unfavourable outlook, owing to the lack of inquiry produced in a large measure by the dearth of shipbuilding orders. Likewise, engineering firms closely allied to the shipbuilding industry experience the same scarcity of business. It has been said that at least one large concern has not booked one order of any importance for over twelve months and that employment beyond the month of May is problematical. The immediate effect of the tariff announcement has been a curtailment in the inquiry for sheets owing to the uncertainty as to the effect on the costs of production. The sheet department has for some time been the one bright spot, especially in respect to light gauges. Imports of material have been comparatively heavy up to date, but they are all against old contracts. Continental materials are not quoted for March delivery, as it has been said that buyers are in some doubt as to whether any portion of the 10 per cent. tariff will be borne by the foreigner. Tubes are in rather restricted demand and production may have to be reduced.

Iron.

Bar iron makers have nothing fresh to report, business remaining on restricted lines, with quotations unaltered. A little extra business has been done in re-rolled steel bars at keen prices somewhere in the region of £6 5s. home and £6 2s. 6d. per ton export, but quotations are likely to rise owing to dearer raw materials.

Pig Iron.

The market for pig iron is extremely modest and outputs are quite sufficient to meet all demands. Continental iron has been eliminated meantime at least, but severe competition from Indian iron has to be met, and considerable consignments from across the border continue to arrive at intervals. Last week 1200 tons from Millom were unloaded at Bowling.

Coal.

The slightly colder weather experienced during the past two weeks has had almost no effect on business. Home buyers held heavy stocks, which they were glad to reduce before buying to maintain reserves. With the season so far advanced it is very doubtful if either collieries or merchants will be able to obtain any increase in price over the usual summer rates. The export demand fails to show any sign of expansion, probably also in a measure because of the holding of heavy stocks abroad. If the decision to withdraw the 15 per cent. surtax on imports into France is adhered to Scottish exporters should benefit. The Danish dairies decision to buy only British coal should also prove beneficial. Against these facts, however, must be placed the imposition of 4·14d. per ton on imports into Germany. Scottish collieries have a considerable interest in this trade. Meanwhile Lanarkshire prime splint is the strongest feature in the Scottish market, this fuel having bookings some time ahead. Owing to considerable selling of treble and double nuts at comparatively cheap prices stocks have been reduced and are now inclined to strengthen. All other fuels are easily obtainable at about current quotations. Aggregate shipments amounted to 262,492 tons, against 228,367 in the preceding week and 196,488 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

French Surtax on Coal Abolished.

THE official announcement was made in Paris on Monday that the 15 per cent. surtax on British coal imported into France was abolished as from that date. The news came as a welcome surprise, inasmuch as fears were entertained that it would be several weeks before the tax would be removed. All the advices which had been received from Paris were to the effect that its abolition would be delayed in view of the change in Government, and that nothing could be done until a new Government had been formed. In view of this fact, the position was that French importers, instead of sending forward their orders, delayed them in order to take advantage of the situation when the tax was removed. Now that it is definite that the surtax is off, orders are coming through more freely, and hopes are entertained that exports to France will show progressive expansion, which they should do, inasmuch as the removal of the tax means anything from 1s. 6d. to 6s. per ton reduction in the price of Welsh coals. The quota system, of course, still obtains, viz., on the basis of 64 per cent. of the monthly average quantities imported into France during the years 1928–30. As, however, South Wales normally ships over 50 per cent. of the exports of coal from the United Kingdom to France, this district should now benefit to a relatively greater extent by an increase in business with our near neighbours. As a matter of fact, the improvement in the orders already on the market has had a beneficial effect upon the outward freight market, and rates have advanced from 3d. to 6d. per ton, and it is very satisfactory to note that freight rates even for large-sized tonnage for the Mediterranean destinations also display a better tone. Such an improvement will be very welcome, as rates have been at a very unhealthy level for all concerned for some time past. Last week shipments from this area showed an advance, the total of 394,410 tons being 31,095 tons better than for the preceding week. Still, the total was materially less than for the corresponding period of last year, when the quantity was 439,521 tons. Except as regards France, new orders on the market continue to be restricted. The Danish State Railways are reported to have purchased their coal requirements, but extremely little has come to South Wales. The Swedish State Railways are also in the market, but here, again, it is very improbable that much of this order will be placed for Welsh coals, particularly in view of the much lower prices ruling for North Country coals, and the competition which will be experienced from Continental producers.

Control of Coal Trimming.

A check to the proposed revision of the system of control of coal trimmers has arisen, as the shipowners' proposals have been rejected by the workmen at Cardiff, Penarth, and Barry. A vote was taken of the men as to whether the employers' clearance house should take over the sole control of trimming in place of the joint control now operating. The workmen's leaders recommended the change, subject to certain safeguards being obtained, but the result of the ballot was 571 in favour of the owners' proposals and 638 against. There were 11 spoilt papers and 211 men did not return their ballot papers. There is to be a further meeting of the Coal Trimming Board to review the situation in view of the vote of the workmen. The object of the suggested change in control was to bring about a more efficient service and improve the dispatch of steamers. Another subject which has caused no little amount of concern locally is the loss of bunkering business in this area. Much of this loss has been to the gain of the North-East Coast, and serious efforts are to be made to recover it. The Great Western Railway Company is, of course, vitally interested in this matter, which came up for discussion at a meeting on Monday last of the South Wales Coal Shipments Advisory Committee. The position is that, whereas in 1929 ports in this channel dealt with 24·9 per cent. of the foreign bunkering trade of the United Kingdom, last year the percentage fell to 21·2.

Unification of Mines.

Members of the Coal Mines Reorganisation Committee, of which Sir Ernest Gowers is the Chairman, visited Cardiff last week and held sittings on Wednesday and Thursday, when leading figures in the coal industry attended to discuss matters concerned with the organisation of the industry. The proceedings were private, but, according to the Chairman and other members of the Committee, they were very pleased with the result of their investigations, and had learned a lot. They stated that it was common knowledge that the process of amalgamation or the enlarging of units had gone further in South Wales than in any other coalfield, but their chief interest was to see what further could be done with regard to the smaller undertakings, and they would have to have another meeting at Cardiff. Reference to the visit of the Commission to Cardiff was made at a meeting of the Executive Council of the South Wales Miners' Federation, held on Friday last, and it was complained that no opportunity had been given to the Miners' Federation to express its views on the question of the amalgamation of collieries. It was decided to communicate with the Miners' Federation of Great Britain urging that workmen's representatives in the various districts visited by the Commission should be invited to give expression to their views.

Tin-plate Items.

It is reported that the South Wales tin-plate manufacturers were to meet this week to consider schemes for terminating unproductive working, and that among them was one which provided that the price of tin-plates should be increased from their present level of 14s. 3d. to 14s. 9d. to a minimum of 16s. It was contended that this increase would permit of the establishment of a pool from which idle works would be compensated to a greater extent than they would benefit in profit if they were working. Present prices are well below the cost of production, and even a basis of 16s. will only produce a small profit for the works in operation. It is pointed out that 16s. sterling represents approximately 11s. on a gold standard, so that the world price of Welsh tin-plates is lower than during the past thirty years. In view of the Government's decision to impose a revenue tariff, the South Wales Siemens Steel Association has decided to make a reduction in its tin-plate bars from £5 to £4 15s. per ton, delivered, to operate forthwith. This decision was come to last week in order to establish the confidence of consumers of steel bars and in the hope of encouraging a larger consumption of British steel. The Landore steel works of Baldwins, Ltd., reopened on Monday. The furnaces were relit and charged over last week-end. About 200 men are employed at the moment, and it is hoped that when they are operating fully work for 350 to 400 men will be provided.

Current Business.

Generally, business has been quiet, except that operations for France have been brisker this week. Supplies of most descriptions of coal are still easily obtainable, and prices have not changed. The loading position has not been too satisfactory, as at the end of last week there were forty-three vacant loading berths at the leading ports, while as the result of week-end arrivals of tonnage, this figure was reduced to thirty-six. The supply of tonnage at Swansea and Port Talbot was inadequate to the needs of collieries in that area, which mainly produce anthracite. It will, however, not be long before the collieries will be looking forward to shipments to Canada, and it is reported that already tonnage has been chartered to load about 400,000 tons of anthracite during the season, on the basis of 7s. f.d. Montreal. Coke and patent fuel remain without special feature, and pitwood is unimproved on the basis of 21s. to 23s. 6d.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE TORONTO INDUSTRIAL COMMISSION announces the formation of a Canadian subsidiary company by the British firm of Simms Motor Units.

MR. T. S. BLENKINSOP, late chief engineer of International Combustion, Ltd., has joined the Mitchell Conveyor and Transporter Company, Ltd., of London and Aberdeen, as manager of the power station department.

EDWARD G. HERBERT, Ltd., of Atlas Works, Levenshulme, Manchester, asks us to state that Mr. Bernard D. Eagin, of Hillary Chambers, Hillary-place, Leeds, has been appointed to be its representative in Yorkshire.

MR. G. E. TAYLOR, chief engineer of the Electric Furnace Company, Ltd., 17, Victoria-street, London, S.W., has been appointed a director of the company, with which he has been associated for over fifteen years.

MR. F. G. HARPER asks us to announce that he has left the service of Victory Valves, Ltd., of Stockport, and has joined the sales staff of John Wright and Co., of Essex Works, Birmingham, and will shortly take up his new duties.

JOHN E. RAWORTH AND MOSS, of 75, Victoria-street, Westminster, London, S.W. 1, ask us to announce that Mr. John Arthur Cook, F.C.I.P.A., has become a partner in the firm, the title of which will, as from March 1st, 1932, be Raworth, Moss and Cook.

NEVILLE'S (LIVERPOOL), Ltd., manufacturers of British-made coil winding and taping machines and vacuum impregnating plant, &c., have transferred their head offices and showrooms to 107–109, Gray's Inn-road, London, W.C. 1. Mr. Eric B. Allam, A.M.I.E.E., has been appointed general manager.

CONTRACTS.

THE ENGLISH ELECTRIC COMPANY, Ltd., of London and Stafford, has received from the Corporations of Preston, Hull, Wallasey, Bournemouth, and Northampton orders for an aggregate of thirty-five double-deck and nine single-deck omnibus bodies. The same company has also received from the Southend Corporation an order for two double-deck trolley omnibuses, and from the Notts. and Derby Traction Company an order for ten single-deck trolley omnibuses.

AEROTO, Ltd., of Bush House, W.C. 2, and Letchworth, has received orders for its patented screw-type fan from Serck Radiators, Ltd., of Birmingham, for cooling transformer oil; from the Roan Antelope Copper Mine, for mining purposes; from the Bank of England, for its new building for ventilation; from J. and E. Hall, Ltd., for dairies; from the Hollywood Masonic Hall, in Belfast, and also the new Masonic Peace Memorial Building in Great Queen-street, London, and from Crown Mines, Ltd., of South Africa.

CATALOGUES.

RUSTPROOFING, Ltd., 11, Thames-street, Sunbury-on-Thames.—Some leaflets on various forms of rustproofing.

BLACKSTONE AND CO., Ltd., Stamford, Lincs.—Publication No. 455 on "Spring Injection" heavy fuel oil engines.

VISCO ENGINEERING COMPANY, Ltd., 162, Grosvenor-road, S.W. 1.—Catalogue No. 321, dealing with air filtration plants.

ALLIED ENGINEERING INDUSTRIES, 4–12, Palmer-street, S.W. 1.—Some particulars of commutator cement, commutator slotting files, and commutator cleaner.

DORMAN, LONG AND CO., Ltd., 55, Broadway, S.W. 1.—Brochure describing a new section of heavy grooved rail for laying down in railway marshalling yards, shipyards, &c.

THE INSTITUTE OF MARINE ENGINEERS.—The thirty-sixth annual dinner of the Institute of Marine Engineers took place at the Connaught Rooms on Friday evening of last week, February 19th, when a large number of members and guests were present. The chair was taken by the President, Mr. F. E. Rebbeck, J.P., and there was a varied programme with musical items interspersed between the speeches. The toast of "The Shipbuilding and Engineering Industries" was ably proposed by Mr. W. N. Raeburn, K.C., who commented on the optimistic note sounded at the Chamber of Shipping meetings, which, he hoped, heralded a brighter future for the shipbuilding and marine engineering industry. In his reply, Sir Hugo Hirst, Bart., the chairman of the General Electric Company, Ltd., gave an interesting personal account of the early development of electricity aboard ship, which, he said, had from small and uncertain beginnings led up to the present extensive use of electrical equipment, both for propulsion and auxiliary services. Sir Henry Barwell, the Agent for South Australia, responded to the toast of "H.M. Dominions Overseas and the Mercantile Marine," which was proposed by Brigadier-General Sir Arthur Maxwell. The toast of "The Chairman" was fittingly entrusted to Sir George Higgins, who paid a personal tribute to Mr. Rebbeck's work in connection with the Technical Committee of Lloyd's Register of Shipping. Sir George expressed the wish that Mr. Rebbeck's term of office as President had coincided with better trade conditions, and said that he hoped the present period of depression would soon pass away and prosperity once more return to the trade and the industry of our country. In the course of his reply, Mr. Rebbeck said how much he valued the support of all who, during his year of office, had helped to forward the work of the Institute.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/6 to 20/–
(1) Spanish	17/– to 21/–
N.E. COAST—	
Native	18/– to 21/–
Foreign (c.i.f.)	16/6 to 17/–

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 8 6	—
No. 1 Foundry	3 12 0	—
No. 3 Foundry	3 9 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 4 0	3 4 0
No. 1	3 4 6	3 4 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(e) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
,, ,, Foundry	3 6 0	—
(e) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(e) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST— N. Lancs. and Cum.— Hematite Mixed Nos.	3 15 6 (a) 4 0 6 (b) 4 5 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	9 15 0	9 5 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 10 0	—
Best Bars	11 0 0	—
Double Best Bars	11 10 0	—
Treble Best Bars	12 0 0	—
LANCS.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 5 0 to 10 7 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 7 6	—
Gas Tube Strip	10 10 0 to 10 12 6	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	9 0 0	8 10 0
,, ,, (Land)	—	—
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 15 0	7 15 0
Sheets (Gal. Cor. 24 B.G.	10 15 0	10 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
,, ,, (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
,, (Small Round)	7 0 0	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
,, (Lancs. Boiler)	8 15 0	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basic)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	6 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars (all British)	7 5 0 to 7 15 0	—
Small Re-rolled Bars	6 12 6 to 6 15 0	—
Billets and Sheet Bars	5 7 6 to 5 10 0	—
Galv. Sheets, f.o.b. L'pool	9 10 0	—
(2) Staffordshire Hoops	9 10 0	—
(d) Angles	8 7 6	—
(d) Joists	8 15 0	—
(d) Tees	9 7 6	—
(d) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 12 6	—

NON-FERROUS METALS.

SWANSEA—		
Tin-plates, I.C., 20 by 14	f.o.b.	14/3 to 14/9
Block Tin (cash)		139 15 0
,, (three months)		142 2 6
Copper (cash)		36 17 6
,, (three months)		36 7 6
Spanish Lead (cash)		14 7 6
,, ,, (three months)		14 6 3
Spelter (cash)		12 15 0
,, (three months)		14 2 6
MANCHESTER—		
Copper, Best Selected Ingots		41 0 0
,, Electrolytic		43 0 0
,, Strong Sheets		72 0 0
,, Tubes (Basis Price), lb.		0 0 11
Brass Tubes (Basis Price), lb.		0 0 9½
,, Condenser, lb.		0 1 0
Lead, English		16 10 0
,, Foreign		14 12 6
Spelter		14 10 0
Aluminium (per ton—raw ingot)	£95	

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/4 per lb.	
Ferro Tungsten	2/– per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 12 6	7/–
,, ,, 6 p.c. to 8 p.c.	£23 10 0	7/–
,, ,, 8 p.c. to 10 p.c.	£22 15 0	6/6
,, ,, Specially Refined		
,, ,, Max. 2 p.c. carbon	£36 10 0	10/–
,, ,, ,, 1 p.c. carbon	£43 10 0	12 –
,, ,, ,, 0·70 p.c. carbon	£52 10 0	13/–
,, ,, ,, carbon free	11d. per lb.	
Metallic Chromium	3/1 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
,, ,, ,,	£11 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£9 15 0 scale 5/– per unit	
,, ,, 75 p.c.	£15 10 0 scale 7/– per unit	
,, Vanadium	12/9 per lb.	
,, Molybdenum	6/3 per lb.	
,, Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£250 to £255	
Ferro Cobalt	10/– per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/– to 13/3
,, ,, Ell	14/3
,, ,, Splint	14/– to 16/–
,, ,, Trebles	12/6
,, ,, Doubles	10/9
,, ,, Singles	9/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	13/–
,, ,, Jewel	17/–
,, ,, Trebles	12/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	11/6 to 12/6
Screened Navigation	16/6
Trebles	12/6
Doubles	10/9
Singles	9/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	12/–
Secondary Steam	11/9
Trebles	12/–
Doubles	10/9
Singles	9/6

(8) N.W. COAST— ENGLAND.

Steams	21/9
Household	32/6 to 51/6
Coke	20/6 to 22/6
NORTHUMBERLAND—	
Best Steams	13/6
Second Steams	12/3 to 12/6
Steam Smalls	8/6
Unscreened	12/6 to 13/–
Household	27/– to 30/–
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/– to 37/–
Foundry Coke	24/–

SHEFFIELD—	Inland.	
Best Hand-picked Branch	26/6 to 27/6	—
South Yorkshire Best	22/– to 23/–	—
Derbyshire Best Bright House	22/– to 23/–	—
Screened House Coal	19/– to 20/6	—
Best Screened Nuts	17/– to 18/–	—
Small Screened Nuts	14/6 to 15/6	—
Yorkshire Hards	16/– to 18/–	—
Derbyshire Hards	16/– to 18/–	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	7/– to 8/6	—
Smalls	5/– to 6/–	—
Blast-furnace Coke (Inland)	12/– to 13/6 on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b., 18/– to 18/6		

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/– to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/–
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/– to 13/6
Ordinary Smalls	11/– to 13/–
Washed Nuts	19/– to 25/–
No. 3 Rhondda Large	19/9 to 20/–
,, ,, Smalls	15/– to 16/–
No. 2 ,, Large	17/– to 17/3
,, ,, Through	15/6 to 16/–
,, ,, Smalls	14/– to 14/3
Foundry Coke (Export)	22/6 to 36/6
Furnace Coke (Export)	17/– to 18/–
Patent Fuel	19/– to 19/3
Pitwood (ex ship)	20/– to 22/–
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	36/– to 38/6
Seconds	27/– to 32/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 48/6
Nuts	40/– to 48/6
Beans	29/6 to 32/6
Peas	18/– to 21/–
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/3 to 8/9
Steam Coals:	
Large	20/– to 20/6
Seconds	18/– to 20/–
Smalls	11/6 to 13/–
Cargo Through	16/– to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate; Joists (minimum), 22/6; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/– if home consumers confine purchases from associated British Steel Makers. (e) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

Sales Comptoirs.

THE only thing that can be done by steel producers and mill and forge owners at the present moment is to organise the industry, and that is being accomplished in so effective a manner that the steel trade promises in a short time to present a solid front. The national Steel Pact is working satisfactorily. There are altogether eighty-seven producers in France, and the pact has been signed by the eleven big firms producing 90 per cent. of the whole. That necessarily means the reconstruction of sales' comptoirs and the formation of new ones, and negotiations with that object in view are now so far advanced that all the steel products will soon be controlled by sales' organisations. That step has been imposed upon makers by the necessity of maintaining prices on the home market and of realising a complete union of all steel interests in order to settle upon the conditions under which import quotas shall be established in the future. The object of producers is to adjust their output to the home needs and to secure reasonably profitable prices, for which purpose the imports of foreign steel would be limited to quantities that would not prejudice the situation of home makers. It is hoped that similar organisations will be carried out in other countries, so that it may be possible to reconstruct the Steel Cartel on a really sound basis for the distribution of foreign business. Nothing else can be done to prevent a collapse of the Continental steel trade. Prices on the international market continue to weaken and are regarded as being definitely below cost.

The Super-tax.

The removal of the super-tax from British coal indicates a change in the attitude of the French Government, which did not foresee that prohibitive tariffs would be imposed upon imports from countries that discriminate against Great Britain. There are reasons why this concession should not be extended too hastily to British manufactured goods, but it is clear that the super-tax must go if there is to be a commercial agreement between the two countries, for an arbitrary tax cannot be accepted as a means of bargaining for trade advantages. It has done nothing to improve the situation of manufacturers in this country, and it is only when they have lost the greater part of their trade connection with Great Britain that makers appreciate the value of the British market. It is felt that there can be no hope of trade improvement without a commercial understanding with Great Britain which may give a needed stimulus to commercial exchanges with other countries, but that needs confidence and goodwill which are not fostered by measures of a discriminating character.

Hydro-electric Supply.

The opening of the Kembs power station by the President of the Republic in June next will mark the completion of the first section of the Alsace Canal which is intended to divert traffic from the Rhine, with its difficult navigation, between Basle and Strasburg, and will, at the same time, provide a total of about 650,000 kW from the generating plants to be installed at the eight locks along the canal. The six turbo-alternators at Kembs will have a total capacity of 186,000 kW. A dam across the Rhine 3 miles from the Swiss frontier raises the water level by about 7 m. The head of water at Kembs will vary from 12 m. to 16·5 m. according to the river level. Another big undertaking which has been put in hand recently is the construction of the Chambon dam—120 m. high—on the Romanche between Bourg-d'Oisans and Grave. A reservoir with a capacity of 50 million cubic metres will regulate the variable supply from the Drac and Isère and the quantity of energy available will be about 70 million kWh a year.

Foreign Trade.

The returns of foreign trade during January show the full effects of the policy of restriction which has been adopted by all countries. In the first month of the year, the total imports were valued at 2340 million francs, a decline of 1445 million francs, as compared with January, 1931. The imports of raw material fell by 45 per cent., and manufactured goods, which totalled 501 million francs, were 263 million francs less than the value for the first month of last year, notwithstanding a small increase in quantity. The total value of exports was 1806 million francs, a reduction of 765 million francs. The exports of manufactured goods declined by 33 per cent. The fact that an increase in the exports of agricultural produce was also accompanied by a heavy decline in prices accentuates further the extent to which values have depreciated. The Minister of Commerce points to a reduction of the adverse balance of trade during the past month as a gratifying result of his commercial policy, but the Association des Grands Ports Français protests that that reduction is due to a heavy contraction of raw material imports and to a sacrifice of the export trade following upon the reprisals of other countries against the special restrictive measures adopted by the French Government.

Railway Accidents.

The derailment of the Vintimille-Paris *rapide* when it was approaching Marseilles on the evening of February 14th was caused by the blowing up of the permanent way by a bomb under exactly the same conditions as the attempts to wreck other international trains on the Continent. The rails were sheared and twisted by the explosion, but though some of the coaches overturned, there was no loss of life, which the railway company attributes to the resistance offered by their metallic construction. More serious was the catastrophe, a short time previously, to the *rapide* from Paris to Milan, which, through the fault of a pointsman, ran on to the up line when entering the station at Meaux and collided with a goods train. The locomotive overturned and coaches were smashed, with the loss of two lives and injuries to many passengers.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

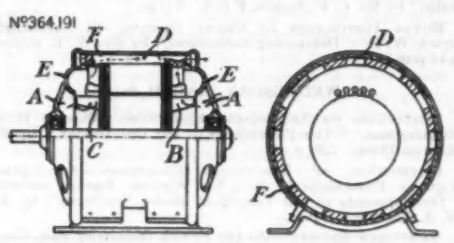
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

364,191. October 7th, 1930.—DYNAMO-ELECTRIC MACHINES, Siemens-Schuckertwerke Aktiengesellschaft, Berlin-Siemensstadt, Germany.

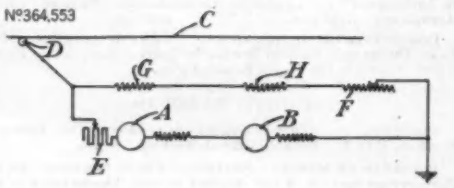
The accompanying illustration shows the invention applied to a squirrel-cage motor. Cooling air is drawn in from outside through the openings A in the bearing brackets by the fans B and C carried by the motor shaft inside the bearing brackets E, and is driven through the duct D in the direction of the arrows. The left and right ends of the ducts D lead alternately into the open air, their other ends being in communication alternately



with the air chamber of the fans B or C. The air drawn in by the fan B, after flowing through one half of the ducts D, will pass out into the open at the driving end of the motor, while the air drawn in by the fan C passes out into the open at the other end of the motor. The cooling air therefore flows in opposite directions in adjacent air ducts D, so that the heat produced in the stator can be carried off in an effective manner. Instead of the sheet steel casing F, a covering of another material—for example, of aluminium or another light metal—may be used, in order to keep the weight of the motor low.—*January 7th*, 1932.

364,553. October 3rd, 1930.—SYSTEM OF ELECTRIC TRACTION UTILISING COMPOUND MOTORS, Louis Bacqueyrisse, of 53ter, Quai des Grandes Augustines, Paris (Seine), France.

This invention relates to electric traction systems using compound-wound motors by which electric braking, regeneration, economic running at low and constant speed and an increase in the commercial speed are attained. The compound-wound motors A, B, connected permanently in series, are fed by the mains line C and the pick-up D, which supplies the current to a starting resistance E. A variable resistance F is connected in series with the shunt windings G, H. The motors are arranged in series so as to provide, under maximum shunt energisation, a greatly strengthened field, ensuring: (1) A strong torque at the commencement of starting; (2) a high rate of regeneration

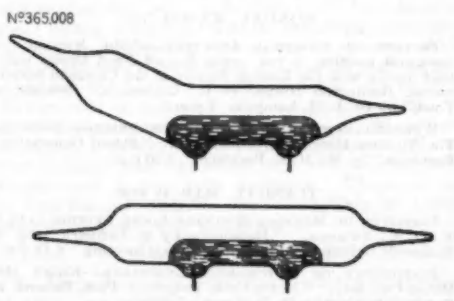


up to the highest speed of rotation, and (3) a reduced and constant speed of the vehicle without it being necessary to interpose resistances between the motor and the line. This result is obtained by the use of a large number of field ampère-turns. On the other hand, in order to cover, by the simple regulation of the field strength, the number of the speeds normally used with ordinary motors and thus to avoid series parallel coupling, the motors comprise all arrangements which will permit of their normal working in an under-saturated condition, i.e. (*a*) commutation or compensation poles; (*b*) a high ratio of field ampère-turns to the ampère-turns of the armature; (*c*) a large air gap; (*d*) a large number of segments in the commutator, and (*e*) a pole piece of a shape providing for a progressive variation of the magnetic field in the air gap.—*January 4th*, 1932.

SWITCHGEAR.

365,008. June 15th, 1931.—MERCURY SWITCHES, N. V. Philips, Gloeilampenfabrieken, of Emmasingel 13 D, Eindhoven, North-Brabant, Netherlands.

Experience has shown that the tubes of mercury switches, which are generally made of glass or quartz, often crack owing to the fact that when the tube is moved the mercury beats violently against the ends or other portions of the tube. Accord-

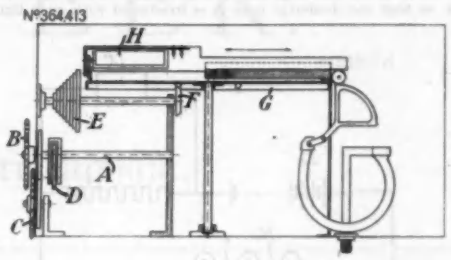


ing to this invention, the portions of the tubes subjected to shock are formed so that the movement of the mercury is braked. Two examples of tubes made in accordance with the invention are shown in the accompanying illustrations, which are self-explanatory. When the tube is not evacuated, the form of construction shown in the lower illustration is preferable.—*January 14th*, 1932.

MEASURING AND TESTING INSTRUMENTS.

364,413. March 2nd, 1931.—APPARATUS FOR DETERMINING AUTOMATICALLY THE WORK DONE BY A ROPE OR CHAIN, *H. D. Elkington*, 20, *Holborn, London, E.C.* 1.

According to this invention the shaft A is driven by a chain mechanism on the sprockets B or C in unison with the rope of the winder. On this shaft there is a planetary wheel D, which



may be engaged with any one of the steps of the coned, toothed wheel E, according to the circumstances. This cone drives, through the intermediary of the bevel gearing F, the disc G. Above this disc there is a "cyclometer" H, the radial distance of which is determined by a Bourdon tube, which is influenced by the tension in the rope—by some means not disclosed—so that the product of the two movements, of the disc and of the cyclometer, represent the work done by the rope.—*January 7th*, 1932.

FURNACES.

364,498. June 1st, 1931.—POWDERED COAL AND OIL BURNERS, F. L. Bolt, 15, Latimer-street, Tynemouth, Northumberland, and the Wallsend Slipway and Engineering Company, Ltd., Wallsend-on-Tyne.

In order to make a burner adaptable for using either powdered coal or oil and to effect the conversion quickly, it is made in the

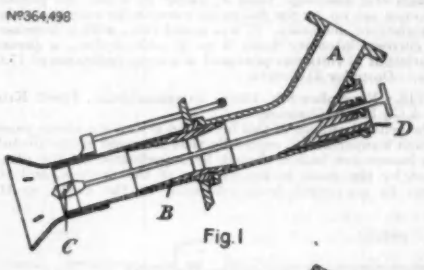


Fig.1

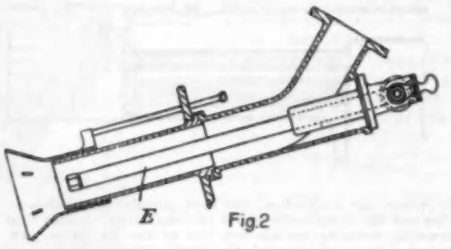


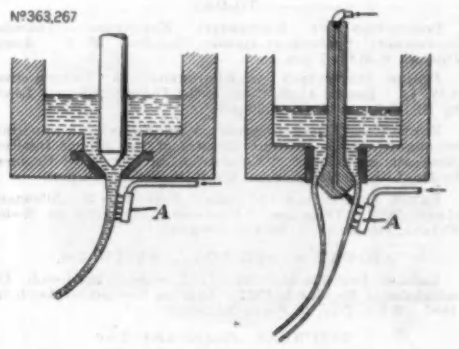
Fig.2

form shown in the drawings. In Fig. 1 it is arranged for burning powdered coal, which is fed in at A, passes through the Venturi orifice B, and the spreader C. When it is desired to burn oil, the plug D is removed, the Venturi is withdrawn by means of the spreader, and a new plug and oil burner E are put in place, as shown in Fig. 2.—*January 7th*, 1932.

MISCELLANEOUS.

363,267. April 21st, 1931.—MANUFACTURE OF GLASS TUBES AND RODS, Compagnie des Lampes, 29, Rue de Lisbonne, Paris (Seine), France.

It is pointed out that it is necessary to rotate a glass rod, or tube, as it passes through the die plate in the process of being drawn, if it is to be truly cylindrical, and of even wall thickness.



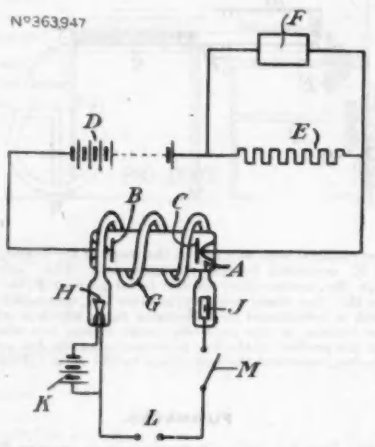
A simple means of producing this rotation is illustrated. As the glass issues from the die it is heated, on one side only, by the burner A. That side of the glass consequently extends and the rod, or tube, tends to bend as shown. The weight of the tube and the pull of the drawing machine are, however, greater than this bending stress, and as a consequence the tube rotates as desired.—*December 17th*, 1931.

363,947. May 16th, 1931.—METHOD OF INFLUENCING THE CURRENT OR TENSION IN AN ELECTRIC CIRCUIT BY MEANS OF RADIATION, N. V. Philips' Gloeilampenfabrieken, Emmasingel 13 D, Eindhoven, North-Brabant, Netherlands.

This specification describes a device for influencing the current or pressure in an electric circuit by radiation. The device comprises a discharge tube A filled with neon. Within the tube are two electrodes B and C, which are connected to the poles of a source of potential D, with a resistance E connected in series.

A device F, which is sensitive to the voltage variations occurring between the ends of the resistance E, is connected in parallel as shown. The discharge tube A is surrounded by a helicoidally wound discharge tube G, which is filled with neon and provided with an incandescent cathode H and an anode J. The incandescent cathode H is fed from a current source K, whereas the discharge tube G is connected to a current source L with the interposition of a switch M. During operation of the device a positive column discharge is established within the discharge tube A. If the discharge tube G is ignited by closing the switch M, so that the discharge tube A is irradiated with neon light,

N°363947

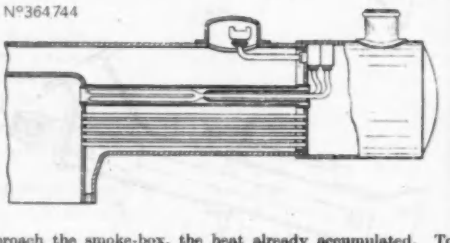


then the light is absorbed by the metastable atoms produced within the discharge tube A, and the atoms are brought into a non-metastable state of higher energy. The irradiation of the discharge tube A with the light emitted by the discharge tube G results in a decrease of the strength of the current passing through the discharge tube A, owing to which the potential difference set up by the discharge current between the ends of the resistance decreases. It was found that, with a decrease of the current intensity from 3 to 2 milliampères, a pressure variation of 17 volts was produced in a series resistance of 17,000 ohms.—*December 31st*, 1931.

364,744. November 8th, 1930.—SUPERHEATERS, Fried. Krupp A.G., Essen, Germany.

The general essence of this invention is that the steam passing through a superheater, especially that arranged in the fire tubes of a locomotive boiler, should be superheated to the utmost extent by the gases in the vicinity of the fire-box, and then should be prevented from returning to the gases, as they

N°364744



approach the smoke-box, the heat already accumulated. To this end the superheater tubes are bifurcated, as shown in the drawing, towards the fire-box end of the fire tubes, and are jacketed by sleeves towards the smoke-box end, with the object of preventing the hot steam from dissipating its heat to the gases, while their efficiency in heating the surrounding water will be enhanced.—*January 14th*, 1932.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Tuesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—Trocadero Restaurant, Shaftesbury-avenue, London, W. 1. Annual Dinner. 6.30 for 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "Recent Applications of the Ternary Alloys of Lead," by Mr. Kenneth Gray. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—In the Lecture Theatre of the Mining Institute, Newcastle-upon-Tyne. "Combustion in Heavy Oil Engines," by Mr. L. J. Le Mesurier and Mr. R. Stansfield. 6 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, W. 1. Discourse, "Uncertainty Principle in Modern Physics," by Mr. C. G. Darwin. 9 p.m.

TO-DAY TO SATURDAY, MARCH 5TH.

BRITISH INDUSTRIES FAIR, 1932.—Castle Bromwich, Birmingham, to March 4th, 1932; Olympia, London, to March 3rd, 1932; White City, to March 5th, 1932.

SATURDAY, FEBRUARY 27TH.

INSTITUTION OF ELECTRICAL ENGINEERS: SOUTH MIDLAND STUDENTS' SECTION.—Visit to the British Industries Fair at Castle Bromwich. Tea in Royal Room. 4.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W. 1. "The Electron," by Lord Rutherford. 3 p.m.

MONDAY, FEBRUARY 29TH.

BRADFORD ENGINEERING SOCIETY.—In the Hall of the Bradford Technical College, Bradford. "The Modern Crude Oil Engine," by Mr. C. H. Bradbury. Illustrated by lantern slides. 7.30 p.m.

ENGINEERS' GERMAN CIRCLE (DEUTSCHER INGENIEURZIRKEL).—At the Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. "Leistungen der deutschen Technik 1931" ("German Technical Accomplishments in 1931"). Illustrated with lantern slides, by Herr Oberingenieur Carl Derschow. 6 p.m.

INSTITUTE OF METALS.—Official visit to British Industries Fair, Castle Bromwich, Birmingham.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Discussion on "The Standardisation of the Frequency of Electricity Supply in Paris," opened by Mr. P. Rieunier, who will exhibit a cinematograph film. Joint meeting with the British Section of the Société des Ingénieurs Civils de France. 7.15 p.m.

SOCIETE DES INGENIEURS CIVILS DE FRANCE: BRITISH SECTION.—Joint meeting with the Institution of Electrical Engineers, in the Hall of the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, W.C. 2. Discussion, "The Standardisation of the Frequency of Electric Supply in Paris." Monsieur P. J. A. Rieunier. 7.15 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS: BIRMINGHAM CENTRE.—Room 178, Queen's Hotel, Birmingham. "The Effect of Commercial Efficiency on Locomotive Design," by Mr. R. G. McLaughlin. 6.45 p.m.

TUESDAY, MARCH 1ST.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Caxton Hall, Westminster, S.W. 1. "Some Problems Connected with High-speed Compression-ignition Engine Developments," by Mr. C. B. Dicksee. Joint General Meeting with ten other societies. 7.45 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, Westminster, S.W. 1. Discussion, "The Pressure on Retaining-walls," by Mr. C. F. Jenkin, F.R.S. 6 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, W. 1. "Detonating Substances," by Mr. W. E. Garner. 5.15 p.m.

WEDNESDAY, MARCH 2ND.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Queen's Hotel, Birmingham. "The Possibilities of the Unorthodox," by Mr. Maurice Platt. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, W.C. 2. Wireless Section meeting. "Developments in the Testing of Radio Receivers," by Mr. H. A. Thomas. 6 p.m.

NEWCOMEN SOCIETY.—At the British Industries Fair, Castle Bromwich, in the New Committee Room, near the Royal Room, extreme east of building. "The Early History of the Magnet," by Dr. J. B. Kramer. 4.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS: GRADUATE SECTION.—Bolbec Hall, Newcastle-upon-Tyne. "Ships' Electrical Equipment," by Mr. J. G. Rutherford. 7.15 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, W.C. 2.—"Motorless Flying," by Mr. E. C. Gordon England. 6 p.m.

THURSDAY, MARCH 3RD.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—In the Chamber of Commerce, New-street, Birmingham. "Gases in Metals," by Mr. S. L. Archbutt. 7 p.m.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Visit to the British Industries Fair, Birmingham.

INSTITUTION OF CIVIL ENGINEERS, INSTITUTION OF MECHANICAL ENGINEERS, INSTITUTION OF ELECTRICAL ENGINEERS: MIDLAND AREA.—Annual Joint Meeting, at the Edgbaston Assembly Rooms, Birmingham. The meeting will partake of the nature of a conversazione. Short cinematograph films of general topical and technical interest, including:—"Laying 1200 Miles of Pipe Line from West Texas to Chicago"; "The Manufacture of the 'Royal Scot' Locomotives"; "Electricity in Agriculture"; "London to Amsterdam in a Vickers 'Vimy' Aeroplane." 7.30 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS: MIDLAND DISTRICT.—Visit to British Industries Fair, Castle Bromwich. Lunch in the Royal Room, 1 p.m.

FRIDAY, MARCH 4TH.

INSTITUTE OF MARINE ENGINEERS.—85-88, The Minories, London, E.C. 3. Annual General Meeting. 6 p.m.

INSTITUTE OF METALS: SHEFFIELD LOCAL SECTION.—In the Non-ferrous Section of the Applied Science Department of the University, St. George's-square, Sheffield. Conjoint meeting with Sheffield Technical Trades Society. "Defects in Spoon and Fork Blanks," by Mr. W. R. Barclay. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, S.W. 1. Informal meeting. Discussion, "Industrial and Commercial Waste," to be introduced by Mr. J. L. Hodgson. 7 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS: NORTH-WESTERN DISTRICT.—Visit to Irlam Works of the Lancashire Steel Corporation, Ltd., Irlam, near Manchester. Assemble at works 12.15 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "The Preparation of Commercial Copper from its Ores," by Mr. T. J. Taplin. 7.30 p.m.

RAILWAY CLUB.—57, Fetter-lane, E.C. 4. Lecture, "200 m.p.h.," by Mr. D. V. Levien. 7.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, Piccadilly, W. 1. Discourse, "Michael Faraday and Electro-chemistry," by Sir Harold Hartley. 9 p.m.

SUNDAY TO SUNDAY, MARCH 6TH TO 13TH.

LEIPZIG SPRING FAIR, 1932.—General Sample Fair, March 6th to March 12th; Engineering and Building Fairs, March 6th to March 13th; Textile Fair, March 6th to March 9th. Open daily.

MONDAY, MARCH 7TH.

SOCIETY OF CHEMICAL INDUSTRY.—Joint Meeting. An inaugural meeting of the newly formed Food Group will be held jointly with the London Section in the Chemical Society's rooms, Burlington House, W. 1. Discussion, "Science and Food," by Dr. L. H. Lampitt. 8 p.m.

WOLVERHAMPTON AND DISTRICT ENGINEERING SOCIETY.—The Victoria Hotel, Wolverhampton. "Steam Generation in Factories," by Mr. H. E. Partridge. 7.30 p.m.

TUESDAY, MARCH 8TH.

INSTITUTE OF METALS: SWANSEA LOCAL SECTION.—At the Y.M.C.A., Swansea. "Metallography in Industry," by Mr. Roosevelt Griffiths. Also annual general meeting. 6.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—King's Head Hotel, Coventry. "Motor Cycle Progress: Past, Present, and Future," by Captain H. D. Teage. 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—39, Elmbank-crescent, Glasgow, C. 2. Scottish Centre. "Recent Developments at Yoker Power Station," by Mr. N. C. Bridge. 7.30 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow, C. 2. "Recent Improvements and Reconstruction Works in Glasgow Harbour," by Mr. A. C. Gardner. 7.30 p.m.

WEDNESDAY, MARCH 9TH.

INSTITUTE OF METALS.—Trocadero Restaurant, Piccadilly-circus, W. 1. Annual dinner and dance. 7 p.m.

ROYAL SOCIETY OF ARTS.—John-street, Adelphi, London, W.C. 2. "Afforestation Work in the Central Plateau of France, with Some Notes on the Work Undertaken at the Military Camp of La Courtine," by Mr. Edward P. Stebbing. 8 p.m.

WEDNESDAY AND THURSDAY, MARCH 9TH AND 10TH.

INSTITUTE OF METALS.—In the Hall of the Institution of Mechanical Engineers, Storey's-gate, S.W. 1. Twenty-fourth annual general meeting. Reading and discussion of papers. For programme see page 137.

THURSDAY, MARCH 10TH.

STEPHENSON LOCOMOTIVE SOCIETY.—At Headquarters, King's Cross. "Some Factors Affecting the Riding of Coaching Stock," by Mr. A. J. Dymond. 6.30 p.m.

FRIDAY, MARCH 11TH.

ASSOCIATION OF EX-SIEMENS MEN.—Gatti's Restaurant, King William-street, Strand, W.C. 2. Smoking concert. Particulars from Mr. J. Snow Huddleston, Dagenham Dock, Essex.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH MIDLAND CENTRE.—Hotel Metropole, Leeds. Annual dinner. 7 p.m. for 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. "The Manufacture of Large Astronomical Telescopes," by Mr. Cyril Young. 7.30 p.m.

SATURDAY, MARCH 12TH.

FINSBURY TECHNICAL COLLEGE OLD STUDENTS' ASSOCIATION.—At the Trocadero Restaurant, London, W. 1. Annual dinner. Particulars and tickets may be obtained from Mr. F. R. C. Rouse, 15, Clifton-gardens, Golders Green, N.W. 11.

MONDAY, MARCH 14TH.

INSTITUTE OF METALS: SCOTTISH LOCAL SECTION.—In the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Some Notes on Condenser Tubes and their Packing," by Mr. J. Stirling; "Non-ferrous Alloys in Marine Engineering: Some Recent Developments," by Dr. J. W. Donaldson. Also annual general meeting. 7.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, St. James's Park, S.W. 1. Graduates' Section. Annual Lecture, "The Strength and Behaviour of Steels at High Temperatures," by Dr. W. H. Hatfield. 6.45 p.m.

INSTITUTION OF RAILWAY SIGNAL ENGINEERS.—Joint meeting with the Institute of Transport, at the Institution of Electrical Engineers, Victoria Embankment, W.C. 2. "Railway Colour Light Signalling in relation to Manual Block and Multiple-aspect Signals," by Mr. A. F. Bound. 5.30 p.m.

TUESDAY, MARCH 15TH.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—In the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. "Refining of Copper," by Mr. R. D. Burn. Also annual general meeting. 7.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Engineering Club, Queen-street, Wolverhampton. "Motor Cycle Progress: Past, Present, and Future," by Captain H. D. Teage. 7.30 p.m.

TUESDAY, MARCH 15TH, TO THURSDAY, MARCH 24TH.

HOLLAND'S INDUSTRIES FAIR.—At Utrecht, Holland. Open daily.

WEDNESDAY, MARCH 16TH.

INSTITUTION OF NAVAL ARCHITECTS.—Grand Hall, Connaught Rooms, Great Queen-street, Kingsway, London, W.C. 2. Annual Dinner. 7.30 p.m.

WEDNESDAY TO FRIDAY, MARCH 16TH, 17TH AND 18TH.

INSTITUTION OF NAVAL ARCHITECTS.—In the Lecture Hall, Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Seventy-third Annual Meeting.

THURSDAY, MARCH 17TH.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—In the Chamber of Commerce, New-street, Birmingham. "The Extrusion of Metals," by Mr. R. Genders. 7 p.m.

INSTITUTE OF METALS: LONDON LOCAL SECTION.—In the Rooms of the Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, S.W. 1. "The Efficacy of Testing Methods," by Dr. H. J. Gough. 7.30 p.m.

THURSDAY TO SATURDAY, MARCH 17TH TO 19TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Scottish District meeting at Ayr.

FRIDAY, MARCH 18TH.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, S.W. 1. Informal debate on engineering topics. 7.30 p.m.

SATURDAY, MARCH 19TH.

KEIGHLEY ASSOCIATION OF ENGINEERS.—Queen's Hotel, Keighley. Annual Dinner: reception, 5.45 p.m.

MONDAY, MARCH 21ST.

INSTITUTION OF AUTOMOBILE ENGINEERS.—At the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Motor Cycle Progress: Past, Present, and Future," by Captain H. D. Teage. 7.30 p.m.

TUESDAY, MARCH 22ND.

INSTITUTION OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE.—North British Station Hotel, Edinburgh. "Commercial Cooking by Electricity," by Dr. T. Settle. 7 p.m.

WEDNESDAY, MARCH 30TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Hotel Metropole, King-street, Leeds. "The Possibilities of the Unorthodox," by Mr. Maurice Platt. 7.15 p.m.

MONDAY, APRIL 4TH.

ENGINEERS' GERMAN CIRCLE (DEUTSCHER INGENIEURZIRKEL).—At the Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1. "Ein neuzeitliches Kesselsystem nach dem Zwangumwalz-Verfahren, System La Mont" ("A Modern Steam Boiler Construction with Forced Circulation, on the La Mont System"). The lecture will be illustrated with lantern slides. By Herr Dr.-Ing. A. Th. Herpen. 6 p.m.

By arrangement with Reuter's Engineering Service, 'THE ENGINEER *contains the latest news from all parts of the world which is likely to be of interest to engineers.*